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CONTRIBUTIONS TO THE KNOWLEDGE OF THE DEVELOPMENT OF THE EYE.

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(*With Plates VII, VIII and IX.*)

IT was the original intention of this paper to describe only the development of the eyelids and not to enter upon any of those tissues which stand in connection with them. As I went on in this course however, I soon found that the condition of the lids could not be separated from their relations to the eyeball. Furthermore, I could not omit directing attention to the development of the lachrymal canaliculi and nasal ducts, especially as in the very beginning of my investigations I came across conditions which essentially differed from the statements of authors. In conclusion I will add some observations on the first appearance of the crystalline lens on which a general agreement of opinion has not been reached.

The embryos used have been exclusively those of mammalia, and it is therefore to be expected that the conditions found will bear some analogy to the corresponding stages in the development of the human eye. That of the ox has been the principal one, as having been the easiest to obtain.

The fresh embryos were placed in Müller's fluid for eight

or ten days; they were then carefully measured, and transfered for a day to dilute and afterward to absolute alcohol. The specimens having thus been prepared, were imbedded in Bunge's mass and cut by the aid of a microtome into a series of sections.

The Lids.

In order to prevent repetition, I will not commence by giving the literature on each subject, but refer to the different articles as we come to the points in question. This is almost necessary as they occur in short notices, none of them presenting a continuous description of the development of the lids with the exception of one article from v. Ammon. His researches were made, however, with the naked eye or with very small magnifying powers.

In the development of the lids, I distinguish three well characterized and distinct stages. The first begins with the commencement of their foundation and ends with their meeting each other over the cornea.

This stage is of short duration and characterized as that in which the lids assume their proper shape, for at its end they have nearly the same form that they have in after-life. When they have united themselves over the cornea, the second period begins, which ends when the lids are again separated so as to leave the cornea free.

This is of much longer duration than the first, but the fact however, is not astonishing as it is at this time that all those complicated structures which characterize the lids, make their first appearance.

With the completion of this separation begins the third and last period. It is characterized as that during which those parts which took their origin in the second stage, complete themselves in form and character.

The elements which characterize this period are also present in the former one, but only in a rudimentary condition, and therefore playing only a minor part; whereas here they become so developed as to give the whole organ its peculiar character. It seems that this division of the development into three stages is based on facts, and it is therefore to be hoped that it will be of advantage.

A.—*First Period.—Origin and Development of the forms of the Lids.*

It is the generally accepted opinion that the lids at their beginning are formed by two reduplications in the skin of the head, the one on the upper, and the other on the lower side of the eyeball.

According to another point of view, a separate elevation is formed around the globe, from which the lids take their origin.

These primitive lids grow forward, meet and become attached together over the cornea, but our knowledge as to their relation to the bulbus, and to the formation of the conjunctival sac is incomplete. Only of late our attention has been directed to this subject.

Manz states that the lids originate as folds from the margin of the cornea. Kölliker on the other hand, declares that they begin behind the equator of the globe; and we will find that both are in a certain sense correct, they having made their observations at different stages of development.

After the sinking of the lens into the secondary ocular vesicle and its subsequent detachment from the ectoderm, the eye recedes further and further from the cerebral vesicle, and becomes larger. On account of the rapid growth, a slight elevation appears in the region of the globe, and later becomes more prominent. This prominence is covered by the ectoderm which in this place without any change in curvature passes over the neighboring parts.

At this period no trace of a fold can be seen which could be taken for the origin of the lids. In the lower part the eye is defined by a moderately deep groove, separating it from the posterior portion of the superior maxilary bone, and losing itself behind the posterior portion of the eye. This groove is the posterior part of the lachrymal furrow, which is situated between the external and superior maxilary protuberances.

In very young embryos, of about 10 *mm.* in length, the two divisions of this common furrow are scarcely to be distinguished from each other.

At a later stage the eye changes its position further downward and thereby carries the lower branch of the lachrymal furrow with it.

By this change in position of the globe, the anterior larger section of the common furrow completes itself and is later recognized as the lachrymal furrow.

The posterior smaller section being dislocated downwards by the globe, becomes later what we will describe as the palpebral furrow,

These two furrows which are intended to serve two entirely different purposes, are united near that portion of the eye which afterwards forms the inner commissure of the lids.*

In embryos of from 20–22 *mm.* in length, the eye forms a considerable prominence, its greater portion projecting above the level of the surrounding tissues.

From this time a considerable change takes place. By a rapid development of the cephalic plates, the eyeball is more or less covered and apparently recedes. The relative rapidity with which the cephalic plates develop, makes the impression that they grow over the eye forming a circular groove around it.

The bottom of this groove which corresponds to the basis of the ocular prominence is thus caused to lie behind the equator of the globe.†

This groove we will call the palpebral groove or furrow, as it plays an important part in the development of the lids. From its edge the eyelids take their origin, and its bottom develops into the conjunctival sac. (Tables vii, viii, Figs. 1 and 2.)

From these statements it follows that the form of the palpebral groove depends upon that of the globe appearing in the shape of a horizontal ellipse.

At first it is shallow, but later it increases in depth, causing its walls to lie closer to the eyeball.

* For a better "orientation" in the above described condition, refer to the wood-cuts of Dursy, page 162 and 163.

† The unequal development of the eye, and the cephalic plates has been described by many of the older authors without having given its relation to the formation of the lids.

It is not uniform in depth, being deeper below, much hallower on the outer side and again deeper upward and inward.

In embryos somewhat older, its depth is materially increased without affecting its other relations to any considerable extent.

This period is however of short duration, and in the next stage we find conditions which have a great influence on the form and position of the eye.

We have already remarked that at the time at which we find the lid furrow beginning to form, the eye has the shape of an elevation projecting beyond the surface of the rest of the head.

This prominence is so great, that the bottom of the furrow is made to lie in a plane behind the equator of the globe.

The depression which subsequently forms around the eye, we have called the palpebral furrow, as it plays an important role in the development of the lids. From its walls spring the lids and from its bottom, the fornix conjunctivæ. (Tables vii, viii, Figs. 1 and 2.)

In a further development we find the fornix coming forward, until in embryos 4–5 *cm.* long, it lies in front of the equator. (Tables vii, viii, Fig. 3.)

This displacement of the fornix is partially due to the same cause which produces the palpebral furrow, viz., the growing of the cephalic plates over the eye. The rapid development in the posterior portion of the globe is also a factor in the displacement motion of the fornix.

In the case of younger embryos (2.5 *cm.*) the anterior portion of the eyeball is relatively much larger than the posterior, the vitreous being very small and the retinal cavity lying close to the lens.

This condition is reversed at a later stage, the posterior wall receding and forming a larger space for the vitreous, causing the cornea to appear smaller.

In this last condition, the forward motion of the fornix is only apparent, occasioned by the change in form of the eyeball.

We have now a further development of the edges of the

palpebral furrow; at first all parts of these walls are alike with the exception of the lateral portions which are somewhat smaller than the others.

Therefore there are at this time no lids or commissures properly speaking. This condition does not continue long. Changes take place very rapidly, which result in the formation of the lids proper.

On the superior and inferior edges of the palpebral furrow the mesoderma pushes itself up in the shape of folds forming the palpebral ridge (Lidwulst) of authors.

In embryos of 3 *cm.* in length, the folds are very short with a relatively thick base.

At 4.7 *cm.* these primitive lids are somewhat longer and thinner, reaching a little beyond the margin of the cornea. (Tables vii, viii, Fig. 3.)

At this time the space between the two lids commences to close, in what way we shall examine later.

Contemporaneously with the formation of the lids, the palpebra tertia makes its appearance, in the form of an elevation of mesoderma in the region of the fornix. It originates in the proximal wall of the inner palpebral furrow.

This elevation is caused by the pushing out of the ectoderm, whose cells are here arranged in several successive layers, the one over the other, whereas at other parts of the palpebral furrow it consists only of two.

The third eyelid soon appears as a short fold, coming directly from the fornix.

In embryos of 4.7 *cm.*, the palpebra tertia is somewhat long and slender, and its epithelium is composed of two layers over the whole extent of the palpebral furrow.

The cells of the upper layer are cylindrical, and their neuclei are at the ends which are next to the furrow.

The structure of that part of the mesoderm which forms the palpebral groove is very simple. It is composed mostly of round and partly of spindle-shaped cells, which later become pushed apart by an increase of intercellular substance. The structure of the eyelid which now begins to be discernible, and also that portion of the lid furrow which later forms the commissures, are no less simple in character.

In the whole extent of the walls of the lid furrow, the cells are much closer together and smaller, and are more intensely colored by carmine. This is therefore to be looked upon as a much more energetic process of development.

In the preceding we have described the first appearance of the lid groove and its original form; and also the beginning of the formation of the lids, and followed it to the time at which the two lids commence to advance towards each other. We have now accurately to describe the more important changes in the lids themselves.

It is generally accepted that they are formed from folds which grow towards each other, and finally unite near the middle of the cornea.

The results of my investigations do not agree with this opinion, as I find that the closing over the cornea is brought about by an entirely different process. The whole condition is completed in so short a time, that we must have the greatest abundance of material in order to form any definite conception of the way in which it takes place. This is perhaps the reason why so many inaccuracies have occurred in the literature on the subject.

It will be remembered that at the first appearance of the palpebral groove, its form depended upon that of the globe. We have here an analogous condition, as the shape of the eye plays an important part in the changes of the shape of the lids.

We have already remarked that at the time of the beginning of the lid groove, the horizontal diameter of the globe was greater than the vertical, (Tables vii, viii, Figs. 1 and 2), giving the globe an oval shape. The vertical diameter then develops more rapidly than the horizontal and in embryos of 4.5 *cm.* in length, they become equal.

By this vertical increase, the upper and under fornices which were then somewhat in front of the equator, (Fig. 3), must be pushed further apart, and the cornea become flatter.

In consequence of this change, the lids are pressed toward each other, and the inner and outer portions of the lid groove which were curved, assume an angular position.

This condition of the commissures is further seconded by the closing of the palpebral fissure.

This closure is brought about by a development of the epithelium of the commissures, which by bringing the corresponding portions of the two lids together makes them take the above-mentioned position.

At the time of the origin of the lid groove, the ocular elevation and its neighboring tissues are covered with an epithelium consisting of two layers, the under one of which is made up of short cylindrical, and the upper of flat cells.

In one position only do we find an exception to this arrangement, viz., on the border of the lid groove. (Figs. 1 and 2.)

There we find the deeper cells to be arranged in several layers one over another, while the superficial layer is still the same.

In embryos of from 3–5 *cm.* this layer is also further developed, its cells become rounder and more transparent, the external one again being flat. In so far as the superficial ones increase and become larger, the deep cylindrical ones become more slender.

Kölliker was the first to describe the increase of the epithelium at the margin of the lids and speak of it in connection with their closure.

I can agree with his opinion, but must add, that this increase is to be seen at the first appearance of the lid groove, and therefore at a time at which there were no signs of the lids themselves; also that the multiplication of the epithelial cells takes place along the whole edge of the lid groove, and is not limited to its upper and lower margins only.

When the lids have become recognizable, it is easy to notice that the epithelium is much thicker at the commissures than at the free margins of the lids. This difference is more conspicuous at the time of the closure of the palpebral fissure. This closure commences at a time when the edges of the lids have scarcely reached the edge of the cornea, leaving the whole space in front of it free. (See Tables vii, viii, Figs. 3 and 4, a. b.)

It has been already shown how the increase in the vertical diameter of the bulbus aided in the formation of the commissures. From these now commences the closure.

There appears to be a regular and equal advancement of epithelium from both lids towards the centre of the cornea as is shown in Table vii, viii, Fig. 4, b. c.

It will also be remarked, that in those places where the closure has not been completed, the lids are wide apart. (Table vii, viii, Fig. 4, c.)

The curved condition of the upper lid is particularly remarkable, and as both lids are very short, the rapid development of the epithelium serves as a communication, drawing the two lids together over the anterior portion of the globe.

On closer examination of the eye in this condition it will be found, therefore, that the lids, though quite a distance apart, are connected by a kind of linear suture at the commissures.

Further inward this growth becomes broader and assumes the character of a thin membrane. (Fig. 4, c.)

In the centre the lids are still free and as already remarked stand wide apart. As the distance between these lateral epithelial membranes becomes less, the lids approach each other, and finally become confluent along their whole margin. There appears now to be in front of the cornea a membrane in which can be seen a small central opening (Fig. 4, d.) which also becomes completely closed by a further development of the epithelial membrane. This membrane, however, soon makes way for a much more solid communication.

We have already seen that at a period a little less advanced, the lids were still free in the middle and stood wide apart from one another, the curvature of the upper lid being greater than that of the under one. (Table vii, viii, Fig. 4, c.) The under lid now seems to develop in a straight line, while the upper remains in its bent condition much longer, becoming pressed down to the lower one only at the end of this stage. (Table vii, viii, Fig. 4, d.) When we consider the fact that this closure of the space in front of the cornea commences at a time when the lids are far apart, or hardly further advanced than the corneal margin, it appears that

this condition plays a very important part in future course of development of the lids. After the appearance of this membrane the lids assume their permanent shape. The fact that, during the development of this membrane the lids stand far apart from one another, shows also that in this condition the development of the lids themselves plays a very unimportant part, the main point being that they become stretched out so as to be long and slender, whereas they were before relatively short and thick. In other words the lids are lengthened, not by any active development in themselves, but passively by being drawn out by the epithelial membrane which grows from their margin over the cornea.

There are also other facts, except the position of the lids at the time of the closure of the space between them, that go to strengthen the above opinion.

For instance, we have seen that before the formation of this closing membrane the fornix was situated near the equator of the globe, (Tables vii, viii, Fig. 3) and immediately after it changes its position so as to lie at the margin of the cornea (Tables vii, viii, Fig. 7). This transposition takes place very rapidly, and it is evident that the simple development in the lids themselves is not sufficient to explain it. There is no other cause that can come into play, except the traction of the membraneous *lid sutures.*

On the other hand, it is not easy to conceive the exact way in which this traction on the lids takes place.

The microscopic examination of the stage when the lids are not yet completely closed, shows that just on their commissures they are bound together by the cells of the rete Malpighii, while further towards the middle the round cells of the superficial layer of the ectoderma push themselves in between the edges of the lids.

In the epithelial membrane between the lids these cells are long and narrow, and have their longest diameter perpendicular to the surface of the membrane. (Tables vii, viii, Fig. 5.) After the closure we find in the *lid suture* only round or slightly oval cells, but no spindle-shaped ones, as in the last condition.

The change of the long spindle-shaped cells into round or

slightly oval shaped, is only possible by a diminution of their longest diameter, and they become thereby shorter by a kind of cell atrophy. There would then be a diminution in volume of the epithelial mass between the lids, and the lids brought closer together by the shrinking of this mass.

The process would be the following: There is a communication between the lids, formed by an epithelial mass, and they would be drawn closer together as an atrophy of this mass took place.

According to this view, the process of the closure of the space between the lids ceases to be unintelligible, and we have seen how important a part it plays in the development of the lids. Upon this process depend in a great degree the forms of the lids and commissures.

Before closing this part of the subject I would like to call attention to a certain point which in my estimation could account for a peculiar malformation of the lids sometimes met with.

We have heretofore sought in vain to find some cause in the development of the lids to which we could refer a coloboma. The view of the older authors that in cases of coloboma of the lids we had to deal with an arrest of development has not been accepted.

It is not my intention to criticise this rejection, but only to remark that in the process of closing of the lids which I have just described, there are periods to which we could ascribe the formation of such a coloboma.

Consider for instance Fig. 4. *c.* and imagine that the process of closure stops at that time. We would have a coloboma of both lids providing there was not a corresponding increase in development at a later stage. On account of this obstacle in the way of the closure (the above provision holding good), the coloboma could only form itself on the upper lid, as the sinus in the under lid is much sooner done away with than in the upper. (Fig. 4, d.) A coloboma could not, therefore, be looked upon as a fissure. It arises only from an obstacle in the regular process of the closing up of the space between the lids, on account of which the edges of the lids cannot be brought together. The

edges of the coloboma are further developed in the same way as those of the rest of the lid. In the two cases recorded by v. Ammon and Cunier, they are furnished with eyelashes.

Corresponding to the above description colobomas are observed either on both lids at once or only on the upper one.

There is one case on record (Cunier) in which this defect was only on the lower lid, and it is possible that it was a mistake.

There has been a case published by Pflüger where there was a defect in the under lid alone, that in the upper one having been covered over by a membrane like the skin. This membrane in Cunier's case could have been easily overlooked.

If a defect of the lower lid alone does occur without any trace of one on the upper, we must consider that the sinus in the upper lid had disappeared before that in the lower, a condition which would be entirely irregular.

I consider the cutaneous tissue which projects into the coloboma between its edges a secondary formation, or a kind of attempt to correct the defect. In most cases it is a very imperfect one, in others (as that of Pflüger) there is really a correction done, and we know only by the absence of the tarsus and cilia that the lid is not a normal one.

In cases where there is a complete failure in the closure of the lids, we have the condition known as Ablepharia totalis. This would show that there was a cessation of the closing process when the bulbus was surrounded by folds which were just discernible. (Fig. 3 and 4, a. b. Tables vii, viii.)

These two conditions have a common origin differing only in degree. Both are simple arrests of development produced by some obstacle, and are easily to be explained as conditions in which certain portions of the lids ceased to develope.

B.—*Second Period.—Appearance and Differentiation of the various separate portions of the Lids.*

At the close of the first period the lids are ready in form,

but their structure is incomplete, being composed of the same germinal cells as when they made their first appearance.

The province of this chapter is to describe the development of the parts which make their appearance at this stage, and although they do not all commence simultaneously, yet they follow each other so closely that at the end of the first half of this period they are all to be seen in their initial condition; then follows their further development and differentation.

As a general rule we can commence by saying that the elements along the margins of the lids are the first to be recognized, as here there seems to be by far the greatest energy in development displayed. This can be assumed from a larger collection of germinal cells and a greater development of the rete Malpighii at this point. Immediately after the closure, that is in embryos of 6 *cm.* in length, the lids are seen as long, thin folds, which are somewhat thicker near their base, and lying close to the cornea.

Their outer surface is smooth as if it had been stretched, and both appear at first sight to be equal in length. On measurement the under one is found to be a little longer. The line between them lies just about the horizontal meridian of the cornea, and since the fornices both above and below are at the corneal margin, the lids seem to have their origin from the corneal basis. (Tables vii, viii. Fig. 7).

It is perhaps from this stage that Manz drew his conclusion that the lids spring from the margin of the cornea, but we have already seen that in their first stages they stand in no kind of relation to that membrane.

We have also seen the reason why the fornix is made to take up a more anterior position. Toward the commissures the fornices are changed so as to be somewhat further back, in fact almost behind the attachment of the iris. This is also very easy to explain. Before the closure of the space between the lids, the corresponding portions in a vertical meridian are furthest apart, and toward the commissure these distances are diminished, and therefore the first must go a greater distance to meet each other, as this is to be accomplished more by the mechanical closure of the lids than

by any special development in the lids themselves. The fornices in a vertical diameter are pulled further forward than in the periphery, where the corresponding portions are closer together.

The edges of the lids do not touch each other but are everywhere separated by the epithelial lid suture. The external and internal surfaces of the lid pass gradually into each other at the margins. The lids are somewhat pointed and there is intermarginal space.

In the neighborhood of the commissures the edges of the lids are somewhat thickened. The inner margin being more definite while the outer is not so well defined.

In the further development the relations just described are much changed. In the general progress, the eye appears to recede, in consequence of which the lids become less curved.

At first they are similar in form, position and thickness, but later the under lid is much more rapidly developed.

This is particularly the case in embryos of 18.5 *cm.* in length, the under being almost twice as long as the upper one.

This inequality has necessarily a great influence on the position of the palpebral fissure, for immediately after the closure, the edges of the lids are both almost exactly in a horizontal meridian of the globe. This development of the under lid causes their line of contact to be pushed higher up. In the above-mentioned embryo it was as far up as the upper pupillary margin.

Toward the end of the period this inequality in length becomes again almost corrected.

The thickness of the two is exactly the reverse. In embryos 8.5 *cm.* long the upper lid is much thicker and continues so until we examine an embryo of 16 *cm.* A little later (as in embryos of 18.5 *cm.*) we have folds appearing on the lids. Before this the lids were smooth and totally stretched. These folds develop more and more and become permanent.

Before the separation of the lids the inner edge is not so well defined as the outer.

It is very interesting to follow the various changes we find in the fornix.

During the first period the lid groove was completely exposed on account of the size of the lids, so that we could see the bottom as far back as behind the equator of the bulbus. By the further development of the lids we have also noticed how the fornix was continually pulled forward (Tables vii, viii, Figs. 1, 2, 3, 5, 6, 7,) and the conjunctival sac became shallower. This is especially conspicuous after the closure of the slit, when in the vertical meridian the lids seem to spring from the margin of the cornea. In this condition the fornix is completely closed and has increased very little in size. Soon after the beginning of the second period we notice another change in the fornix, by which it is made to recede regularly and slowly backward. I am unfortunately not in the position to explain why it does so. I will, however, mention one fact which may play a part in it. From the beginning of the period the epithelium of the fornix is composed of several layers, whereas that of the cornea and the inner surfaces of the lids has only two.

It is possible that the whole condition is brought about by an active increase and pushing in of this epithelium into the loose tissue of the orbit.

In the process of development of the lids we have seen conditions which would account for the formation of coloboma, and in the same way we can here account for another malformation of the eye in the development of the fornix.

According to the investigations of v. Ammon the condition known as symblepharon cong. is not to be accounted for by an arrest in development, but by some inflammatory changes in fœtal life.

This explanation holds good in many cases, but it is questionable whether it is the only one or indeed whether it is the probable one.

Immediately after the closure of the lids, the conjunctival sac is very shallow, its posterior wall being formed by the cornea. That portion which afterwards forms the conjunctiva bulbi is wanting, and it can only be produced by the

receding of the fornix towards the equator of the eyeball. If we now imagine that there were some obstacles in the way of the backward motion of the fornix in any particular place, we would have an apparent attachment of the lids to the sclera, while the remainder of the conjunctival sac would attain its normal state.

We could therefore explain a symblepharon cong. without any inflammatory process, it being simply produced by an arrest in a certain stage of development of these parts, precisely as we had coloboma of the lids.

Simultaneously with the appearance and further development of the parts just mentioned, changes in the structure of the substance of the lids occur.

We have already seen that immediately after the closure of the lids, they are made up of small round cells which lie very close together.

On the margins and the inner surface these cells are smaller and more compact, assuming a much deeper color on treatment with carmine. In embryos of 10 *cm.* in length the orbicularis reaches the free margin of the lid and divides it into posterior and anterior divisions.

Later these cells are increased in number; there is also more intercellular substance which is homogeneous or slightly fibrous in character. Still later we find bundles of connective tissue, especially between the fibres of the orbicularis, which can be traced to the outer surface of the lids where they form a fine net-work.

At this time the palpebral conjunctiva makes its appearance as a distinct membrane, from the fibrous layer on the posterior surface of the orbicularis.

We will now examine the formation of the cilia, Meibomian glands, etc., but first the epithelium and the lid suture as they form the points of reference in the following description.

The Epithelium of the Lids and the Lid Sutures.

After the closure of the lids the epithelium of its outer surface is composed of a deeper layer of cells (rete Malp.), and two or three superficial ones, and during the

whole second period only the superficial ones become increased in any way. This proliferation is greater near the margin, and decreases regularly towards the basis of the lids where it is the least. In embroyos of from 20 to 25 *cm.* we have the epidermis making its appearance as a thin layer of flat cells which are later without nuclei. At the margin the rete Malp. is distinguished by the length of its cells. Where it passes over to the outer surface of the lids its cells become smaller and lose themselves in the corresponding layer of the surface. At the inner edge this change is much more abrupt, as the large cells of the margin come in immediate contact with the smaller ones of the inner surface. Through this whole period this condition remains the same, only the difference in the size of the cells becoming less. In embryos of 25 *cm.* I first found pigment granules in these cells, and in that half which lies next to the cutis, but shortly before the separation of the lids these were entirely filled with dark pigment. It was visible from the openings of the Meibomian glands along the margin of the lids and to some extent along their outer surface.

The inner surface remains for a long time covered with an epithelium composed of two layers only, the deeper cells being small and the superficial ones flat. In embryos of a length of 25 *cm.* these cells are found to be larger.

The older authors did not agree as to whether the lids were grown together or were merely connected (Fr. Arnold) by a secretion from the Meibomian glands.

Donders was the first to show that they were attached by an epithelial suture.

I am also of this opinion with the reservation, that in the suture the cells of the rete Malp. are not to be found, but only those which correspond to the epidermis. This is contrary to the opinion of Donders. (Figs. 7, 8, 9). Only at the commissures, and even there but for a short time after the closure of the lids, could I find the conditions described by the last-mentioned author.

The greater mass of the lid suture is made up of transparent epithelial cells, which appear round or oval in sections made perpendicular to the surface.

The oval shapes are better to be seen near the under surface of the suture where they are smaller and flatter. They stand with their largest diameter transversely to the palpebral opening. (Figs. 8 and 9).

The matrix of all these cells is the mucous layer of the lids which is composed of a row of cylindrical cells, which can be distinguished by their length from the elements of the neighboring portions of the lids. (Tables vii, viii, Fig. 8).

These two species of cells do not abruptly pass into each other, but are separated by others which are smaller and round, and which color only slightly with carmine.

In sections made perpendicular to the cleft between the lids, the suture is constricted at the point corresponding to the sharp projecting margin of the lid, and is divided into a larger anterior and a smaller posterior part.

This suture is not confined to the space between the lids, but as Schweigger-Seidel first pointed out, it continues some distance from it on their inner and outer surfaces, where it gradually loses itself in the epithelium. (Tables vii, viii, Figs. 7, 8, 9.)

Its thickness is not constant, generally diminishing toward the commissures, but this is not always the case.

In later stages its shape and size depends upon that of the lid margin. It is therefore evident that with the increase in thickness of the lids its horizontal diameter must also increase, and with this approach to one another its extent from above and beneath diminishes.

In the vicinity of their inner edges the lids are nearest to each other, and the corresponding shape of the suture must here change and assume the shape of a triangle with its base turned outward (in a cross-section). All of these changes in the suture take place slowly and regularly, and it is first in embryos of 20 *cm.* that the last mentioned condition can be observed.

Meibomian Glands.

According to Kölliker these glands are a late production being formed from the epithelium in a solid condition and

producing their cavities later. This view I can also substantiate, but must trace the details further as a complete description of this process has not yet been given.

The first traces of these glands I found in an embryo of 8.5 *cm.* in length. With small magnifying powers places strongly colored with carmine can be seen, in sagital sections, near the inner edges of the lids. Here the cells of the rete Malp. are longer, and there appears a collection of small round cells between this layer and the epithelial cells of the suture.

At the same time or a little later than this active process in the epithelium, there is an increase in the cells of the mesoderma at corresponding places (Fig. 8). After this we find a slight depression of the epithelium which pouches further and further in, until we have the formation of an epithelial cylinder.

The peripheral cells of the epithelial depression are cylindrical, and stand with their axes transversely to the direction of the gland, and are continuous at the opening with the rete Malp. The central cells are round and fill up the space formed by the cylindrical ones. This continual inward progress must naturally push the cells of the mesoderma along with it and they form a sheath around the cylinder, being much more numerous at the bottom. The direction of the depression is parallel to the inner surface of the lids.

In embryos of 14 *cm.* in length these glands appear as a cone of solid tissue, narrower near the mouth. (Fig. 9.)

At this time a change takes place in the cells in the middle in such a manner that at the mouth they become larger, their protoplasm is increased, and they are not so deeply colored with carmine.

This metamorphosis is best seen in the anterior portion of the gland; the cells at the bottom become smaller and remain otherwise unchanged. On account of the increase in size of the cells the mouth of the gland becomes broader and the gland is equal in its dimensions through its whole depth. In embryos of 18.5 *cm.* we see again another change in the shape of the cylinder made by its sending-out offshoots. The first one of these offshoots

appears as a small, solid development near the mouth. Immediately after, we have a formation of many of them, always near the opening and generally on both sides at the same time. The first ones being the oldest and largest, and the others decreasing in size as we go back gives the whole appearance to the gland as if it were thickened at the mouth and decreased in size toward the bottom. (Fig. 10. Tables vii, viii).

These offshoots are solid at this time, in fact their whole development is analogous to that of the gland itself, being lined with epethelial and filled with small cells.

The only difference is that these cells are not homogeneous, but finely granular and polygonal in shape. The primary offshoots become broader at their base.

The secondary offshoots now commence to be formed from the primary and appear as a kind of a nodule on their sides. The primary do not extend quite to the bottom of the gland, this portion remaining for some time free from off-shoots. It distinguishes itself also by differences in structure. Its cells are smaller and take the carmine more readily.

It is only at a late stage in the formation of the gland that we find the bottom also giving off these branches. At this time the cells in the center commence to become fewer in number and are pushed out of the gland, thus forcing the lid suture against the cornea.

This pushing out of the contents of the gland into the lid suture can be very easily overlooked as the cells are as homogeneous as those of the suture and differ from the latter by their taking carmine more readily.

At this time we have also the formation of alumen in the gland which has heretofore been solid.

In glycerine preparations we can see granular masses in the centre of the offshoots. Small dark granular extensions into the main path of the gland are formed from these masses, which become connected together in the middle of the gland tract, and then run as simple striations towards the mouth. On treatment with absolute alcohol these small dark granulated fat cells disappear more or less completely

and we then see, instead of the dark paths, small canals in the substance of the gland. This fatty condition of the cells which is to prepare the formation of the lumen, commences in embryos of 25 *cm.* in length or shortly before the separation of the lids.

It has already been shown that the glands in the beginning are surrounded by the cells of the mesoderma which are crowded together at the bottom as in Figs. 9 and 10. This condition remains unchanged for some time, as I found only in embryos of 25 *cm.* in length that the gland is surrounded by a distinct fibrous capsule. From this capsule I then found many septa composed of cells going in between the offshoots. It only remains to be remarked that in embryos of 18 *cm.* the glands are surrounded on all sides by the muscular fibres of the orbicularis.

The Eyebrows.

As their development is so analogous to that of the lashes, we will examine them both together in order to prevent repetition. I will only remark that the appearance of the brows commences at a very early period of fœtal life. They are to be seen at the time when the lids have just commenced to assume their form as in embryos of from 2.5 to 3.0 *cm.*

The Eyelashes.

These are of a later origin, and only appear after the lids have become completely closed. If we examine sections of the lids of one embryo of 6 *cm.* with small magnifying powers (lenses), we find places on the outer surface of the lids in the vicinity of their margins, which are to be distinguished from the neighboring tissue by the intensity of their coloring with carmine. Closer examinations will show these to be localized growths in the stratum Malp.

The cells become longer and proliferate, and the product of this increase causes a collection of small round cells to lie between the rete and stratum corneum.

The cells of the mesoderma do not remain passive while theseprocesses are going on. In corresponding places in it

a circumscript development also takes place and an increase in small round cells makes its appearance, as was the case in the formation of the Meibomian glands. (Tables vii, viii. Fig. 8).

In these active processes on the part of the epithelium and mesoderma there appears in some instances a slight elevation, but this never becomes very great. In a later stage the rete Malp. which has been thickened as above stated, recedes in the direction of the mesoderma thus forming a shallow depression (Fig. 8) which becomes deeper and forms one of the epithelial cylinders as in Fig. 9.

The walls and bottom of these epithelial protuberances are composed of cylindrical cells which lie perpendicular to the axis of the follicle, and are always to be recognized as continuations of the deepest layer of the skin. The cells in the centre are small and round, showing no particular arrangement. As this epithelial cylinder sinks in, the cells of the mesoderma must naturally be carried in front of it.

From the moment this sinking-in commences, the hair follicle becomes surrounded by a sheath of round cells from the mesoderma which can be distinguished by their smaller size from the surrounding tissue. At the bottom of this follicle the mesodermal cells are greatest in number. (Figs. 8 and 9).

There are two opinions in regard to the first stages in the development of the hair follicles, the one advanced by Kölliker, holding that the principal process consists in the formation of epithelial cylinders which sink into the mesoderma by an active growth in themselves; the other by Reissner and Götte who consider the development in the mesoderma to be primary, and the formation of the follicle to be secondary. The follicle is forced passively into the depression in the mesoderma.

It is unquestionable that both these ideas have been material advances in the history of development in so far as they have both called attention to the active part taken by the mesoderma in the process. Feiertag considers the formation of the mesodermal sheath to take place much earlier than Kölliker, while Schulin thinks that it is contemporane-

ous with, or a little in advance of, the increase in the epithelium.

According to my observations, Reissner and Götte are not correct in their statement, that the formation of the hair follicle commences in the mesoderma and therefore its formation is anterior to that of the epithelial cylinders.

It is true that in certain parts of the body we find appearances which seem to strengthen their opinion, for instance, in the eyebrows. These do make their first appearance by a prominence which is perceptibly elevated above the surrounding tissues, and their prominence is formed from the mesoderma. The epithelium is already increased above it, but has not yet begun to pass inward.

I do not find any reason, however, to call the development in the mesoderma a papilla in its usual acceptation.

The first appearance of the hair is in a development of the epithelium with a corresponding development in the mesoderma simultaneously or immediately after, but it depends entirely upon the circumstances whether this is to be called a papilla or not, in the sense of Reissner and Götte.

The formation of these nodules is cæteris paribus, produced by an increase in the epithelium and mesoderma, and this increase is greater in the eyebrows than in the cilia, and also greater in the cilia than in the hair of the external surface of the lids.

The resistance offered by the epidermis however, plays a very important part; since the less it is developed the easier it will be raised up by the formation of the hair bulb, and as its layers are continually increased in number this resistance becomes constantly greater.

We see then that the opinion of Feiertag that those hairs which have an early origin are accompanied by this nodular development, whereas those of later origin are without them, is correct.

I do not consider the formation of these nodules to be especially requisite for the hair, as it happens in very few portions of the body. It must also be remembered that there is an exactly analogous process in the development of the Meibomian glands, that is, a thickening of the epithelium and

mesoderma, and a subsequent involution of the latter by the advancing epithelial process; but in this case we would certainly not speak of an involuted papilla.

We have now followed the development of the cilia to the formation of a solid epithelial cylinder. This cylinder developes rapidly at the bottom, and extends almost as far as the posterior surface of the under lid, where it bends round with its lower end in the direction of the base of the lid.

Its structure remains for some time unchanged; in embryos of 16 *cm.* long interesting changes are first seen.

With the appearance of the sebaceous glands, we observe that the cells in the centre of the upper portion become more transparent and commence to push out from the hair-cylinder until they reach the superficial layers of the ectoderm. We have then a solid offshoot from the mouth of the hair-sack, which is composed of transparent cells and which has an oblique direction to the surface. (Tables vii, viii. Fig. 11).

This offshoot is almost as large as the hair itself, and has its end pointing more in the direction of the base of the lid.

I will here remark that I have seen this condition not only in the eyelashes but also in the brows and on the nose.

In the last-mentioned place it is particularly easy to see how it is turned aside from its course by the epidermis, after having penetrated almost the whole ectoderm, and made to run some distance between the epidermis and the remaining ectodermal layers. It has been observed before that longitudinal elevations appear at those places where the hairs are to break through the surface, and these elevations were regarded as having been produced by the pressure of the developing hairs. I do not agree with this opinion, but would rather consider them as having been formed by the continual advance of the epithelial tracts already mentioned, especially as there is no trace of hair at this time to be seen. The existence of an epithelial offshoot from the hair-sack seems to have been unknown to all preceding observers. In the new edition of Kölliker on the history of

development, I find only a passing observation, and even this is more in reference to the germinating branches.

The structure of this tract is also of such a character that it can easily be overlooked, since it is also composed of transparent cells like the ectoderm through which it passes. These cells are, however, much smaller, and are slightly colored by carmine. It is, however, sharply bent to one side in the direction of its exit from the hair-sack, whereby it may happen that it does not lie in the plane of the section.

A further change consists in a fatty degeneration of the elements of the epithelial offshoot. In glycerine preparations we then see the transparent tract change into a corresponding granular mass.

This mass can be followed in the direction of the sebaceous glands, where it often divides into two smaller tracts which pass into these glands. (Tables vii, viii. Fig. 12).

The fat becomes absorbed on treatment with absolute alcohol, and there remains instead of this dark streak, a well-defined canal which passes into the sebaceous glands.*

The fat globules were first described by Simon and considered as sebaceous glands.

Götte somewhat later defined them more extensively, but failed to state anything definite as to their nature.

Kölliker does not mention them at all in his new work. Feiertag denies their existence, and Schulin connects them with the development of the sebaceous glands.

The drawing has been made from a preparation which had been treated with absolute alcohol. I can only state myself that in those sections in which sebaceous glands were found, I could always follow the fatty tract into them. It is certain that they are not identical with the glands as Simon declares; nor is it at all probable that these fat molecules are a secretion of a gland in such a rudimentary condition. On the whole, I am inclined to consider them as being formed by a fatty degeneration of the transparent cells of the epithelial offshoot, and therefore formed *in loco*.

* In Tables vii, viii. Fig. 12, the fat globules are not represented in the upper part of the canal.

This process is of the greatest importance in the further development of the hair, as it assists it in its exit.

All authors agree that the hair developes from below, presses against the delicate ectoderm and finally breaks its way through. I cannot confirm this, as according to my observations, the passage by which the hair is to pass through the upper skin is indicated and completed before the skin has been formed.

By the fatty degeneration of the central cells of the epithelial tract which passes out of the hair-sack towards the surface, and the subsequent absorption of the fat, we have a canal of the same size, form and position, with well-defined walls. At this time the hair proper is not present, and only becomes visible after the completion of the canal.

If this channel is sharply bent in its course, the fine, sharp-pointed end of the hair may catch against the walls, which causes it to assume many changes in curvature at these places, but generally it passes through smoothly, without meeting any obstruction.

The structure of the inferior large division of the hair-sack remains for a long time unchanged, in fact until the embryo has reached a length of 25 *cm.* Then commences the formation of the hair proper. For the want of time I am unfortunately not able to give a description of the process which takes place in the hair-sack from this time until the hair makes its exit. I will however remark that this exit takes place in embryos of about 40 *cm.* long and before the separation of the lids.

Immediately after the appearance of the cilia, we also see hairs between them and the margin of the lids, but they never attain the size of the former.

The hairs of the remainder of the lids commence to form slowly, but there does not seem to be any particular order in their development.

If finally we make a comparison in the later stages of development of the cilia and Meibomian glands we find a wide difference in this structure, whereas in the beginning both were formed by an increase in the epithelium and the mesoderma in the same way.

In both cases there is formed a solid epithelial cylinder surrounded by a sheath of mesoderm, the development of which sheath appears to be most advanced at the bottom. (Tables vii, viii, Figs. 8 and 9.)

In both almost at the same time the first buds grew near the opening, in the case of the hair the sebaceous glands and in that of the Meibomian glands their first root. The epithelial cells of the interior undergo fatty degeneration in both cases, thus forming a canal.

The analogy is complete until we have the formation of the papilla in the case of the hair. In the middle the hair cylinder remains always solid, and shows a relation between the papilla of the hair and the sheath of the root, whereas in the Meibomian glands the central cells undergo fatty degeneration and the solid cone becomes the main channel of exit.

The Sebaceous Glands of the Lashes.

The rudiment of these glands I have noticed in embryos of 16 *cm.* in length, or quite a time before the hairs themselves appear. There was no decided increase in the thickness of the wall of the hair-sack, and the process was only to be recognized by the fact that a few of the round cells of the wall of the cylindrical sack had become larger and clearer and showed a fine, punctate appearance. (Tables vii, viii, Fig. 11.) These cells become more and more numerous and at the same time the wall shows a bulge, and the gland appears as a small appendage to the hair sack. Its base is turned towards the base of the latter, and its walls are composed of small cubical cells, which merge into the peripheral cells of the sack at its mouth.

The cells in its centre are somewhat larger, are round or polygonal with transparent and finely granulated protoplasm. (Tables vii, viii, Fig. 12.)

These glands are therefore from the beginning composed of two distinct kinds of cells and are not homogeneous at first, with a later change of character in the centre as is stated by Kölliker.

In embryos of 30 *cm.* in length, the gland presents the appearance of a long solid offshoot, from the walls of which the secondary offshoots are formed.

Shortly before the separation of the lids, the gland looks like a bunch of small grapes which are still in a solid condition. They all open later into the under portion of the canal already described for the passage of the cilia out of the hair-sack.

The Sudorific Glands.

There are many species of sudorific glands distinguished by their structure, form, etc., but the distinction is not very definite and we can properly speak only of two kinds, viz., large and small. Only one kind of these possesses any peculiar characteristic, namely, the glands of Moll on the margin of the human eyelids. To this species belong the great majority, if not all of the sudorific glands of the lids of cattle. They are not developed in exactly the same manner as other sudorific glands, and I will therefore give a few of the characteristic details of their development, as to my knowledge they have not yet been pointed out,* and Köl-liker's description refers only to common sudorific glands.

The first traces of these glands I found in embryos of 14 *cm.* long. There is then only a bulging out of the wall of the hair-sack a little above the region of the sebaceous glands.

They are to be distinguished from these last mentioned glands, by the fact that the cells in their centres are not large, clear and finely granular, but are always small and round like those of the hair-sack. They appear to be made up entirely of one kind of elements. (Tables vii, viii, Fig. 9.) From this time the gland developes quite rapidly and always parallel to the direction of the hair-sack. It is very narrow and solid, being of a somewhat greater diameter at the lower end. Shortly after this appearance we see a narrow, small transparent streak in the direction of the axis of the gland, which runs between the contours of the cells, and

* Sattler examined a later stage.

appears in places interrupted and somewhat winding, corresponding to the contour of the neighboring cells.

This is the beginning of the formation of the lumen, which therefore seems to be produced by the cells in the centre becoming pushed apart. In embryos of 18 *cm.* long the gland is longer, but the lumen is still very narrow. The walls are composed of flat oval cells, which stand out somewhat in the track of the lumen. (Figs. 11 and 12).

Later these glands become as long as the hair bulb of the cilia. The lower, thickened end is bent, and around the whole lumen there develops a delicate sheath of epithelial cells.

Shortly before the separation of the lids, these glands are longer than the cilia themselves, and the lower ends are sometimes so bent as to pass under the papilla and appear on the other side of it.

The cavity is much greater at this time, especially as the inner end and the walls are made up of a single row of flat cells, surrounded externally by a delicate sheath of connective tissue.

The sudorific glands of the other hair-bulbs of the lids are formed in the same way as those of the cilia.

It is, however, peculiar that the glands are always on the side of the hair-sack opposite to lid margin. I have never been able to find them in any other position, nor have I found their termination in the subaceous glands, as is not unfrequently the case in man.

M. Orbicularis.

This muscle is entirely wanting in the early stages of development. I have only been able to find it in embryos of 4 *cm.* long, and therefore at a time at which the lids are perfectly recognizable. In this condition of the lids, it can be seen at their base. but not at all projecting into their substance. In vertical sections it then appears in the shape of bundles of muscle fibres, which are not very plainly striated.

In the beginning of the closure of the lids (embryos 4.5—5.0 *cm.* long), it projects a little into the lid substance,

whereas at the completion of this closure it is to be seen in the under lid in the entire half toward the base, but not quite so far advanced in the upper. It then pushes slowly on towards the margin, which point it reaches in embryos of 8–10 *cm.* long. In the further development of the eyelashes and Meibomian glands that part of the muscle in their vicinity can be easily distinguished, and may afterwards be described as M. Riolani's.

In embryos of 18 *cm.* long it presses in between the Meibomian glands and the inner surface of the lids, so that these glands become completely surrounded by its fibres. At a still later period we find isolated bundles of these fibres between the hair-bulbs near the margin of the lids, and running in a transverse as well as a longitudinal direction around them.

There also appears another muscle in the lids that has its fibres perpendicular to the direction of the palpebral aperture, at about the same time as the orbicularis. It is much less developed than the latter, and always lies on its anterior side. In the region of the margin it only consists of isolated bundles, which can only be distinguished with great difficulty from the rest of the lid.

We have heretofore spoken of a pushing forward of the muscle into the substance of the lids, but not in the sense of an actual forward motion. In the case of the orbicularis, it is more probable that it developes itself passively from the cells of the lid, and not simultaneously in all its parts, but successively from the base towards the margin.

Separation of the Lids.

According to my observations, the separation takes place in embryos of from 40 to 47 *cm.* in length. The first endeavors to explain this process we owe to v. Ammon. He states that there appear on the posterior surface of the lid suture small openings produced by absorption, which become larger and form a line of absorption, and the lids are then separated first at the inner canthus, but he does not trace it to any other part of the lid margin. I think, how-

ever, that the openings he speaks of are the mouths of the Meibomian glands that I have already described when discussing their development. It is quite easy to conceive that they could produce such an effect as he describes, as each one of them has its mouth running backwards through the lid suture, and they may form his line of absorption.

Schweigger-Seidel has shown that canals are formed in the lid suture corresponding to the bulbs of the cilia, which coalesce and open externally.

These canals are identical with those I have described in connection with the development of the hair-bulbs.

According to the last-mentioned author, the transformation into horny tissue of the cells in the bulbs which leads to the development of the body of the hair, takes place externally, as the bulbs are closed sacks of epithelial cells.

I have already shown that the canals in question appear long before the formation of the cilia, and are produced by a fatty degeneration of the cells in the epithelial offshoots.

They are not peculiar to the eyelashes, as I have found them in connection with other hairs. They have nothing to do with the separation of the lids, since they are found all over the body where there is hair.

It cannot be denied that they assist in the separation where they are present in the suture, as is the case in the human eye.

In the embryo of the ox they play no part in this, as the cilia are entirely beyond the limit of the suture.

There is another circumstance of importance in the separation of the lids which I must mention.

Shortly after the closure of the lids the anterior surface of the suture is flat or a little curved, varying in its degree. It therefore makes the impression that the cells of the suture become pushed up out of the palpebral fissure, and run some distance backward over the lids, and we notice in embryos of 18 *cm.* long that the suture which was before convex outward now becomes so inward.

In a sagittal section the surface seems funnel-shaped; in later conditions the apex of the cone is pushed further in-

ward and aproaches the posterior surrface of the suture, thereby diminishing its thickness.

The separation in the case of the ox takes place from before backward, and in the direction of a line between the middle of the posterior and the anterior surface of the suture. This sinking in of the anterior surface of the suture is brought about by a retrograde metamorphosis in its cells.

The other cells remain clear and unchanged, while here we have them dull and opaque, as if there were a mist around them, and in the body of the cell itself fine lines make their appearance, which later form a kind of network.

They then collapse; their walls become wrinkled, and finally there remains only an imperfect network, which gradually disappears as the suture recedes.

II.—*Conjunctiva.*

There is very little known about the development of the conjunctiva,

The older authors considered that the eye was covered by the outer skin, as long as it was free, and after the closure of the lids this skin was transformed into the conjunctiva.

Even v. Wecker has taken this opinion as the accepted one in a recent description of a coloboma. We know that so long as the eye projects above the surface of the head it is only covered by epithelium, there being no question of a skin or even cutis (v. Wecker), the summit of elevation being made by the cornea and the sides by the sclera.

Von Ammon was the first to present more correct views. According to him the conjunctiva bulbi is first formed, and it then passes over to the inner surface of the lids, and finally unites with their margins. He has not declared, however, from what material it is produced. This is all we find in the literature of the subject.

We shall see that the conjunctiva in its origin depends more or less upon the fornix, and we shall therefore describe this first. It has already been shown that the fornix

is behind the equator of the globe in the beginning, and in the course of the first period of development it came slowly forward, and at the closure of the lids it reaches the corneal margin.

This of course holds good only for those parts that are in the vertical meridian of the globe, or not far removed from it.

The more we approach the commissure, the further is the fornix from the cornea, and in the horizontal meridian it lies behind the insertion of the iris. This, however, has all been spoken of before, and we have only to remember that at the beginning of the second period the fornix recedes, and this is where it plays an important part in the genesis of the conjunctiva bulbi and the posterior portion of the conj. palp.

We will therefore examine more fully into the condition of affairs at this stage. I shall call attention to a narrow band of tissue which comes from the cavity of the orbit, and runs parallel to the outer surface of the sclera at a little distance from it.

It passes into the substance of the lids and close under the epithelium of the inner surface, and looses itself further forward.

This band is composed of round and short spindle-shaped cells, which lie close together and are deeply colored by carmine.

From its position and further differentiation, I consider this the commencement of the formation of Mueller's muscle. Between this and the sclera we find a small space which runs from the fornix back into the orbit. In this space we find also round and spindle cells embedded in a slightly fibrous and transparent intercellular substance.

This is the condition shortly before the closure of the lids. We know also that at this time the fornix begins to recede, and it must therefore be pushed back into the tissue described above, between the sclera and musculus palp., and divides it into two portions. The cells are pushed aside, and are found between the fornix and sclera on the one side and the musculus palp. on the other.

The epithelium of the fornix therefore does not lie in contact with the sclera or muscle, but is separated by the cells of the space which we have seen above.

These cells are to be regarded as the matrix of the conjunctiva bulbi and posterior part of the conj. palp.

The fornix continues to recede from the corneal margin until it has reached the place where it is to remain in afterlife, and the conjunctiva completes itself in the same way.

This is the general mechanism. We will now go more minutely into the histogenesis of the membrane.

In young embryos the conjunctiva bulbi appears in a sagittal section in the form of a triangular piece of tissue, whose apex is at the corneal margin, and whose base is turned towards the orbit. The cells are round and oval, sometimes spindle-shaped, and lie in an indistinctly fibrous matrix, and somewhat far apart. The limits of this tissue towards the cornea and sclera are not so marked, but they can be distinguished by a less compact condition of the tissue, and by the absence of any regular stratification which is distinctly to be seen in cornea and sclera. Posteriorly it is continuous with the tissues of the orbit.

From the manner in which the conjunctiva takes its origin, we can see why it is always more developed in the upper half of the globe than in the lower. Where it passes over to the cornea, there is no change in the level of the surface, and the epithelium of the cornea becomes continuous with that of the conjunctiva.

There is as yet no trace of relation of the limbus. There is a difference in the relation of the layers of epithelium, which takes place very soon, so that after the closure of the lids the whole internal space (which later forms the conjunctival sack) is lined by an epithelium composed of two layers. The deeper one of these is made up of small cubical cells, except on the cornea, where they are cylindrical. The superficial is composed of flat cells.

At the fornix the epithelium is thicker by several layers.

Soon after the closure of the lids the fornix begins to recede from the corneal margin, and the conjunctiva is thus covered by the epithelium of the fornix. It therefore ap-

pears that the conj. bulbi at its very beginning has several layers of epithelium, whereas that of the cornea remains for a long time composed only of two.

At the corneal margin the epithelium of the conjunctiva is thickened by the appearance of several layers of round cells between the two layers that are present in the cornea.

The surface of the conj. remains smooth for a long time; in embryos of the length of 25–30 *cm.*, it first becomes uneven, and just before the separation of the lids we meet with comparatively large papillæ. These may be folds partly produced artificially in taking out the eye.

At earlier stages, the conjunctiva lies close to the sclera, and it is in embryos of 35–40 *cm.* long that we first see the formation of a peculiarly loose connective tissue between them, which could be called a submucosa.

In younger embryos the surface of the cornea is evenly continuous with that of the conjunctiva, but later this condition is changed, so that the conjunctiva is raised up and seems to surround the cornea like a frame.

In this premature limbus (in embryos 40 *cm.* long) we soon see long, narrow glands that resemble very much the sudorific glands at the commencement of their formation.

Glands are also to be seen a little earlier in the fornix which are tubules, but they are broader. In neither case could I find offshoots of them, and therefore I cannot decide whether they are the acino-tubular glands of Krause or not.

The structure of the conjunctiva just before the separation of the lids is very loose, and cannot be distinguished from the submucosa.

Under the epithelium alone are the cells closer together.

The epithelium is always composed of several layers of flat cells, and the superficial ones first become larger in embryos of the length of 20 *cm.* They also appear peculiarly transparent. With the increase in size of these superficial cells, there is a change in form, and they become more cylindrical, the deeper layers remaning unchanged.

All of these changes commence in the fornix and extend toward the corneal margin, but never reach it. It is quite

peculiar that the cylindrical cells assume the form of papillæ, especially in the vicinity of the fornix, in the formation of which the connective tissue of the conjunctiva does not take part. A further peculiarity is that in embryos of 25–30 *cm.* in length we meet with large mucous bodies between the cylindrical cells, which bear a great resemblance to the chalice cells in the intestines.

The above description of the conjunctiva bulbi, properly speaking, holds good only for those portions where the fornix lies close to the corneal margin. Where they are somewhat separated, the superficial layers of the sclera must play a part in the process.

In the beginning of the second period in the development of the lids, the posterior surface is distinguished from the rest by the fact that its round and oval cells are grouped together and are colored deeper with carmine.

The fibres of the muscle of Müller become lost in this layer soon after their entrance into the substance of the lids. This condition remains unchanged for some time, but it is not quite proper to call it already the conjunctiva palp., for although its cells are more densely pressed together, yet it passes so gradually over to the rest of the lid that it is impossible to find any line of separation.

In embryos of 25 to 30 *cm.* long, this tissue may be seen as a membrane easily to be distinguished from the remainder of the lid.

The conjunctiva palp. is composed at this time of round cells which are not very close to one another, and the intercellular substance is much more distinctly seen in the shape of fine fibres, which form a close net-work.

This membrane becomes separated from the rest of the lid by a fibrous layer of connective tissue, the analogue of the tarsus.

In the upper lid this is not so plainly seen as in the lower, for a loose connective tissue lies beneath the conjunctiva.

The inner surface of the lids seems to be smooth, as if it were stretched before the conjunctiva has made its appearance as a membrane and lies close to the cornea; as the

formation of the conj. palp. goes on, the connection between these two membranes becomes less intimate, and the surface of the lid begins to be uneven.

In the region of the palbebra tertia, on the lower lid, we have very beautiful papillary elevations. This takes place in both lids near the fornix, and shortly before the separation of the lids.

The epithelium of the conj. palp. is composed in the beginning of two layers, one made up of small cubical cells, which pass into the rete Malp. at the margins, the other is composed of flat ones.

This is the condition of the epithelium until we reach the fornix. Here it is composed of several layers, and this is also the condition on the posterior portion of the conj. palp. Later, the superficial cells in this locality become longer and larger, while the deeper layers remain unchanged.

The larger anterior portion of the conjunctiva (corresponding to the tarsal portion in man) remains covered with two layers of epithelium until the separation of the lids, only at the margin of the lids more layers are there.

Here, as in the case of the conj. bulbi, we find formations similar to the cells of the cutis.

The further development of the conjunctiva, and its condition after the separation of the lids, I have not followed, but from the facts just stated, we can divide the conjunctiva into two portions, viz: the conj. bulbi with the posterior part of the conj. palp. and the actual conj. palp., and this division has reference to a different mode of development of the two membranes so that the well-known difference in the structure of these two portions of the conjunctiva in after life is also present in the fœtus.

III.—*The Lachrymal Apparatus, and the Glands of Harder.*

Lachrymal Gland.

Remak was the first to give an accurate account of the development of these glands. Kölliker has also examined them in mammalia, and stated that they are first formed in the shape of solid epithelial cylinders, which later become hollow, and which have, at least in the ox, hollow offshoots.

I can substantiate this opinion.

The first traces of this gland I have found in embryos of 2.8 to 3 *cm.* in length.

At this time it appears as a thickening of the epithelium at the place where the lid groove passes over from its outer to its upper portion. A little later it becomes bottle shape, with body quite thick and its neck thin.

In embryos of 4.3 *cm.* in length, it has the appearance of a sack 0.6 *mm.* in length, but very narrow. At first it is solid, but later it becomes hollow to the end, and its cavity about 0.01 *mm.* wide.

From the mouth where it is only 0.032 *mm.* the gland becomes broader, until it reaches a breadth of 0.088 *mm.* Its mouth is lined with two layers of cells which are continuous with the corresponding epithelial layers of the lid groove.

The cells in the interior which are nearest to the cavity are transparent, and have their nuclei in the end pointing inward. The peripheral cells are more granular in character and are colored much deeper with carmine.

This distinction can be easily remarked at all places except near the bottom, where it becomes less. Here there are many layers.

The further development of the lachrymal gland takes place principally in a longitudinal direction, with the formation of offshoots from the posterior end at the same time.

In an embryo of 8 *cm.* long the gland was 1.5 *mm.* long, and had one opening duct 1.0 *mm.* in length, which divided into several shorter ones near its lower end, upon which were small offshoots. All of these secondary divisions and offshoots, etc., appear hollow.

The duct which leads from the gland is lined by an epithelium of two layers of the structure and arrangement just described.

In the offshoots the epithelium near the bottom is composed of several layers and is granular, and the cavity is very small.

Harder's Glands.

The physiological signification of these glands is not quite settled, and it may be that the description of their development is out of place. I have decided to give it, however, from the fact that they have an analogous mode of development to the lachrymal glands, and also from the fact called attention to by Wendt, that in cases where there is a better development of these glands the lachrymal gland is wanting, and when we have a well developed glandula lacrymalis the glands of Harder are not present, giving us an idea that they are analogous in function.

I have not been able to find in the literature of development any reference made to these glands, except a few remarks by Rathke, who examined them at a later stage, and considered them to be formations from the buccal mucous membrane.

In an embryo of 4.3 *cm.* in length I found the first sign of these glands, as a tube 0.14 *mm.* in length, which had its opening in the lid groove close to the fornix, and on the concave side of the palp. tertia (Table ix, Fig. 17).

The tubular glands, with narrow cavity, appear to be relatively large in comparison to their length, but the inequality between the size of the body and the neck is not so striking as in the case of the lachrymal gland. The structure of the two is the same. It is very probable that the first stage of these was also solid, but I have not seen them at that period.

In an embryo of 4.7 *cm.* they were longer but thinner, and small offshoots could be seen.

The further development, as in the case of the glandula lacrymalis, seems to be principally in a longitudinal direction and the formation of hollow offshoots, which last develope to larger branches of the gland from which new offshoots are put forth (Table ix, Fig. 21).

I would only call attention to one difference, and that is, the offshoots from the lachrymal gland come from the blind end or its vicinity, whereas in the case of the glands of Harder, these are also found near the mouth of the gland.

The Lacrymal Canals and Nasal Duct.

The older authors have only speculated as to the development of the tear ducts. v. Baer for instance considered it probable that they are formed by an involution from the pharynx, which grows toward the eye, whereas Burdach believes it to begin at the internal canthus. Erdl and Coste have called attention to the fact, that the "so-called" lachrymal furrow becomes closed and recedes from the surface, thus giving rise to the whole canal, from the eye to the nose simultaneously. This last opinion has remained as the accepted one up to the present time.

Undoubtedly it has much in its favor, since it is easy to demonstrate that as long as the lachrymal groove exists there is never a trace of the canal to be seen, whereas with the disappearance of the first we have the canal already being formed, but of course in a very primitive condition.

The view which Erdl and Coste take is entirely hypothetical, and must remain so until it can be demonstrated by sections made and examined with the microscope.

Born has produced a work lately not at all in accord with this opinion. According to him the lachrymal canals in amphibia appear as an epithelial tract, which commences on the surface, and grows downward from the eye to the nose. It is at first solid, and after becomes hollowed out on the surface, and gradually growing inward forms a continuous canal. In reptiles only a comparatively small portion of the canal is first formed in this way, the lower anterior end being then gradually prolonged in the direction of the nose, and thus the part of the canal originally wanting is formed. In birds the same conditions are found as in amphibia, only the epithelial tract commences from the bottom of the lachrymal groove. It will therefore be seen that the opinion of Born differs fundamentally from that of Erdl and Coste; and the question is such an important one that I consider a rehearsal of the whole subject to be particularly desirable.

A comparison between the results of Born's investigations and my own is difficult on account of the material

used, but as the conditions in the eye of the ox are more analogous to those of the human subject, I give them as I have found them.

That portion of the lachrymal furrow which lies between the superior maxillary bone and the external nasal protuberance, runs from the eye towards the olfactory fossa.

In frontal section this appears in embryos of 1.8 *c.m.* long, as a triangular space with its corners rounded off, and its base turned upward and outward, with the apex inward and downward, as is shown in Table ix, Fig. 14.

The walls of this groove are lined with epithelium, which is continuous with the similar layer of the head surface. On account of this lining, the space is made much narrower, and the walls stand in close proximity to one another. In the immediate vicinity of the eye, the groove so changes its form that it becomes less steep inward and below, and is continuous with the lower lid groove.

At a little later stage, in embryos from 1.9–2.0 *cm.* long, there are seen traces of the first formation of the nasal duct, which traces are to be seen in the whole extent of the lachrymal groove.

These are shown by an increase in the lining epithelium, in consequence of which the walls of the groove not only touch each other, but there is thus formed a solid conical-shaped body, which is connected by a well-defined pedicle with the remainder of the ectoderm (Table ix, Fig. 16).

On account of this transformation of the greater part of the lachrymal groove into the solid conical figure, it becomes much shallower, and therefore has a tendency to become closed up by the formation of the lachrymal canal.

On closer examination, we can distinguish two kinds of cells in this new-formed portion. In the peripheric part they are placed radially, and are formed into two or three layers, the one over the other, while the central cells are round ones.

Shortly after the formation of this conical epithelial body it becomes completely separated from the surface, and if we imagine that this formation and separation takes place along

the whole extent of the lachrymal groove, we would have a solid closed epithelial tract of cells parallel to the original lachrymal groove, which would represent that which produces later the lachrymal canal.

It is highly probable that Born and myself have found similar results, but our explanations are different.

According to his investigations, the ductus naso-lacrymalis in birds is developed from the bottom of the lachrymal groove in the shape of a solid cone, and the groove plays only the part of marking out the position for the formation of that organ, without having any active influence on the process of formation. In my examination I find that the greatest part of the groove itself (considered in a frontal section) is actually transformed into the lachrymal canal; and if this be true, the groove must become shallower and disappear, as is actually the case.

The lachrymal canal is therefore the modified groove which detached itself from the surface, and not a separate development which takes place from the bottom of the groove.

A comparison of the length of the groove in a tissue just before and after the appearance of the canal shows that it has not been changed in length, a condition which ought not to exist if Born's opinion be the correct one.

On the contrary, it should be deeper by the whole length of the epithelial cone, which is not the case (Table ix, Figs. 14 and 16).

From these facts I consider the opinion of the older authors, that the lachrymal groove becomes transferred into the canal, to be the correct one; however, not in the shape of a hollow tube, but of a solid epithelial tract, which becomes later changed to a canal.

In regard to the anterior end of the lachrymal canal which opened into the nasal cavity, I can state, that in sections made through the anterior end of the groove in the vicinity of the wall of the olfactory fossa, a short time just before the formation of the canal, we find the groove connected with the wall of the primitive nasal cavity by a short, solid, epithelial tract. (Table ix. Fig. 13.)

From the position of this connection and its relation to the lachrymal groove, and nasal cavity, I consider it to be the first formation of the anterior end of the canal.

Until very recently little has been known about the development of the lachrymal canals. Kölliker is of the opinion that the lachrymal groove bifurcates, thus producing two depressions which afterward become closed, and form the lachrymal canals, and states that if this be not the case, he knows of no other explanation than to consider them as offshoots from the upper end of the lachrymal passage.

We are indebted to Born for a more acurate examination of this point. He describes several ways for the formation of the canalic. lacrym. as it differs in different animals.

In amphibiæ the epithelial tract which runs from the nose to the eye divides into two short branches near the eye, the undivided portion becoming the lachrymal canal, and the two branches the lachrymal ducts. In reptiles only that portion of the posterior lachrymal duct which lies next to the point of division is formed in the manner just described, while the remainder of the posterior, the anterior lachrymal duct and the whole lachrymal canal are secondary formations produced by offshoots from the first mentioned division.

In birds the formation of all of these parts is the same as in amphibiæ.

(He has, however, changed this last in a letter to Prof. J. Arnold, and stated that the anterior lachrymal duct is a secondary formation from the lachrymal canal.)

I have not had the opportunity to examine these different species of animals, and cannot give my opinion in the matter, but must say that I have not found any of these in the case of the ox.

If we examine a series of frontal sections of the lachrymal passage at the time it is being detached from the surface, we observe that as we approach the eye, the epithelial cone, which we have already described, becomes changed in form and position.

The base of this cone which before was directed inward, now turns downward and assumes a position almost perpendicular to the wall of the inferior lid groove along its whole extent.

We also notice an elevation on the epithelial cone which is very small at first, but becomes more and more so as we approach the eye. Near the internal canthus the base of the epithelial cone becomes divided so as to form two secondary cones. (Table ix. Fig. 15.)

The form and size of these secondary cones are different in different sections, but the above relations are seen in most preparations. The epithelium of this double cone is composed of a peripheric layer of cells placed radially and an internal one of round cells, as was the case in the single cone.

From these appearances we must then conclude that in this premature state the canalic. lacrym. take their origin from a common source, and are identical in shape and form. This separation takes place from below, and they lie in a horizontal plane, the one behind the other.

Later they lie one over the other, but how they separate and take this position I am not able to say. Probably these processes are connected with the simultaneous closure of the lid-furrow towards the lachrymal furrow.

After having noticed the origin of the lachrymal canal and ducts and their separation, we will now examine their further development somewhat more closely.

In cross section of the lachrymal duct we find cubical cells arranged in a radial manner in the periphery, lying in several layers one over the other.

Those in the centre are round as in Fig. 19. The protoplasm is only slightly developed in both cases, and the nuclei are therefore comparatively large. At this stage the canal remains unchanged for quite a long period, increasing only in circumference.

In embryos of 3.5–4 *cm.* in length we then notice a further change which takes place, especially in the central cells. Where we saw before only a homogeneously colored disk in carmine preparations of sections of the canal, we now find

the middle more transparent, and surrounded by a redder ring as in Fig. 20.

This condition is produced by the cells in the middle becoming increased in size, and the protoplasm which was scarcely visible before is also much increased in volume. The cells assume a polygonal shape, or have an irregular contour. With the further increase in the size of these cells, the protoplasm becomes more transparent and is less deeply colored by carmine. The cells in the periphery remain unchanged. This transformation in the canal can also be seen in the ducts.

Immediately after the closure of the lid fissure, or in embryos of 6 *cm.* in length, a new stage in the development of these parts begins. Before the closure they are all in a solid condition, but after it they have cavities in their centres. The formation of these cavities always commences at the mouth of the ducts and proceeds backward.

In the *canals* this hollowing out commences somewhat later, and progresses slowly, and we never find it complete in embryos of less than 10 *cm.* in length. At this time the *ducts* are much further advanced.

The formation of the cavity does not take place continuously from the eye towards the nose except in the case of the ducts. In the canals we often find solid spots between two places where the cavities have been already formed, and it is always certain that when the anterior end has been completed we can still find places further back in a solid state. The process by which the lumen is produced is the same in the entire lachrymal apparatus, and therefore the following will answer for all.

We have seen that after the canals have made their appearance, a change takes place by which the central cells are increased in size, and their protoplasm becomes more transparent. In a further development the ductus naso-lacrym. is increased in diameter on account of this growth in the central cells. The cubical cells of the walls remain unchanged and form a small ring around the transparent center as in Table ix, Fig. 20. After or perhaps a little time before the closure of the lids we find small holes occurring at intervals,

which give the impression that they have been produced by a destruction of certain cells which before held their places.

As to the precise manner in which this degeneration takes place, I can only say that the cells become almost perfectly transparent, and lose their nuclei, so that on a superficial examination they are hard to recognize. After the degeneration of the nuclei they become rounder, sometimes spherical and finally disappear entirely.

These spaces occurring in the region of the central cells become more and more numerous, coalesce, and thus very irregular fissures are formed. When this has taken place along the whole extent of the organ the cavity is complete.

At first the cavity is very narrow and sometimes irregular in diameter, the wall having a zig-zag shape.

If the cells are not all destroyed at the same time, we have a kind of a net-work of those that remain, as is shown in Fig. 18. In other places where the lumen is tolerably wide, it is again made narrower by an increase in size of these remaining cells.

All of these stages are best seen in longitudinal or cross-sections of the canal or ducts. Gradually this net-work of remaining cells disappears, the cavity becomes broader, and the walls smoother, but this goes on so slowly that the process is terminated only in embryos of 10 *cm.* in length. In an embryo of 16 *cm.* which I examined, the cavity was wide, its contour entirely smooth. The epithelium was composed of several layers of flat cells, which consisted of one layer of peripherical cells and several layers of more transparent epidermoid cells.

I can only make a few remarks on the part the mesoderm plays in the development of these organs. During the separation of the canals, I did not observe any remarkable change in its character, its cells remaining round and grouped together, as is the case in other portions of this germinal layer.

I have sometimes noticed that as long as the canal remained solid, these mesodermal cells were grouped in concentric layers around it, but this is not always the case. In embryos of 16 *cm.* we can, however, observe that in this

vicinity the mesoderm does not appear so compact, which may be considered as the beginning of the formation of the mucous membrane.

The position of the anterior end of the canal remains about the same as it was just after the separation from the surface.

Its mouth is found near the external opening of the nasal cavity below and in front of the inferior turbinated bone. From this place the canal passes along the outer wall of the cavity of the nose, backward and upward toward the eye. In older embryos the different parts of the cartilaginous walls of the nose and turbinated bones become formed.

It would be too great a digression for me to describe a further development, and I will therefore content myself by giving the position of the lachrymal canal of an embryo of 6 *cm.*

From its mouth it takes an upward and backward course, remaining close to the epithelium of the nasal cavity. Further back it lies inward and upward from the anterior process of the external cartilaginous wall of the nose.

Just in front of the junction of this wall with the cartilaginous plate of the inferior turbinated bone it runs exteriorly to the plate, and beneath the turbinated bone. It remains for some time separated from the nasal cavity only by this plate. Further back this plate disappears, and it then lies under the turbinated bone and close to the epithelium of the nasal cavity. In this position it remains for some time, when we find it taking its course upward and outward. It becomes further and further separated from the nose, and finally divides itself into the two lachrymal ducts already described. I found it also in about the same position in embryos of 16 *cm.* in length, but the walls of the nose were much further developed, and the bony capsule was beginning to form.

At the time of the first appearance of the lachrymal canaliculi from the middle of the inferior wall of the palpebral furrow, we find their openings in young embryos, not on the margin, but on the wall of the lid groove.

Later the openings are closer to the margin, but it is

not until the lids have closed over the cornea that we find them in the vicinity of the internal canthus.

IV.—*The Lens.*

There have been but few publications on the condition of the lens at its first appearance, and these disagree so much in every particular as to invite further attention to the subject. The principal point is, whether in the case of mammalia the lens is formed as a hollow involution of the entire mesoderm, or is it at first solid, to become later a cyst by absorption of the central cells. The latter view, first advanced by J. Arnold, has been opposed by Kessler, Kölliker, W. Mueller, and by Lilberkühn, who found the same mode of development for the lens of the mammalia as for the chick.

v. Mihalkowics considers that both ideas are in a measure correct, and states that the lens itself in mammalia is produced by a sinking-in of the active ectoderm, and that it becomes solid by a development in the passive ectodermal cells.

I have had for examination four embryos of the ox of 10 *mm.* in length.

These were treated, some with osmic acid and some with Müller's fluid, and then put into Bunge's imbedding material, and the whole head cut with the microtome in successive sections in order that no portion of it should be lost.

The globe is slightly prominent above the rest of the head at this time, and is covered by the ectoderm which is also somewhat elevated as it passes over it.

The ectoderm is composed of several layers of cells at this place, but all the cells are the same in character.

I was not able to discover the existence of a distinct layer of flat cells (passive ectoderm).

In frontal sections, the top of the ocular elevation is formed by the superior anterior wall of the primary ocular vesicle, which is pushed back so as to form a slight cavity, and the lens takes up its position in this cavity. This action on the part of the lens is produced by a sinking-in of the ectoderma, which is thickest at this place, being

composed of cells placed radially, and in several layers one over the other. Toward the wall of the cavity for the lens, these layers become thinner, but are continuous with those of the remainder of the head. This lens cavity or groove is not empty, but filled with a plug of cells which is raised above the entire surface as is shown in Fig. 22, Table xi. These cells are round and have indistinct nuclei, and between them quite a quantity of finely granulated detritus is to be seen. The walls of the lens cavity which are produced by the ectoderm are separated from this by a sharply defined line, and the whole detritus mass seems to lie loosely in its position.

In one embryo this mass was almost entirely detached, but kept in its position by the walls of the lens having somewhat closed around it.

I must oppose most decidedly the opinion of Kessler and Kölliker that this mass does not in reality exist, but is produced by folds or the section being too thick or too peripheric, etc.

In every section which passes through the lens cavity, I could plainly see this mass, and its volume depended upon the position of the section whether it passed through its centre or more to one side.

I would therefore state that it is absolutely certain in the case of the embryo of the ox that this mass in the lens cavity does exist.

The condition which I have just described agrees with the opinions of J. Arnold and v. Mihalkowics, in so far that these cells exist. They are not separate and distinct from one another, but they form altogether a mass which completely fills up the lens cavity.

It is much easier to demonstrate their existence than to determine their origin and destination. According to my opinion there can be only two ways in which they could have been formed;—the one, they are produced *in loco* or they are transported there from without. In the first instance they could only have been formed as a production of the ectoderm, which has undergone a degeneration, on account of which the cells present the appearance of

a mass of detritus, clearly defined from the remainder of the ectoderm as we have already described. This would also account for the fact of its being pushed up higher than the surface of the head as is sometimes the case. Nevertheless I have not been able to find in any one of the four embryos a condition which actually demonstrated a formation of these cells in the above manner.

The second possibility is that these cells are not formed *in loco*, but come from some other locality to be deposited in their proper places. With the exception of the form of these cells, there is nothing to make one think they are foreign to the part, and even if we were to consider them as wandering cells we could say nothing as to their origin, as in the whole science of embryology we have no analogous condition.

I must therefore confine myself to simply mentioning these two possibilities, and trust that other investigators will decide this question which I am not at present in the condition to solve, as it is absolutely necessary to examine a great collection of material in order to arrive at any definite conclusion.

The demonstration of the frequent existence of these accumulations of cells is nevertheless an advance in the proper direction.

In an embryo of 12 *cm.* in length, the lens has just detached itself, and its cavity is only partially filled, the cells being few in number, and all near the part where the opening had been in the capsule. I can confirm the opinion of J. Arnold that these cells do not take any active part in the formation of the lens fibres, but disappear soon after the lens vesicle has been closed. I would like to call attention to the fact that at this time there is a slow increase in size in the lens vesicle, and after this period the cells of the posterior wall commence in the well-known way to be transformed into the lens fibres.

One more observation before we finish. All authors, with the exception of Kessler, state that there is always a part of the mesoderma between the ectoderma and primary ocular vesicle. I have had two ox embryos of 5.5 and 8 *mm.* respectively, and one of the rabbit of 3 *mm.*, which I have ex-

amined in a series of sections, and in every case have found this layer of mesoderma, though, of course, it was quite thin. In the rabbit this layer was composed of three layers of cells, in the ox of one; and I therefore state that according to my preparations, a layer of the substance of the mesoderm always exists between the ectoderm and the primary ocular vesicle. I was not able to detect a layer of mesoderm behind the lens immediately after it had been pushed in. Whether this layer atrophies on account of the stronger development of the primary ocular vesicle, or whether it is broken by the lens as it is pushed into this vesicle, or whether it is simply transformed into a homogeneous membrane which becomes difficult to detect, I am also unable to state.

I have appended a table to show the time and order in which all the parts described in this article make their appearance, but naturally its value is only a relative one.

Receding of the lens, in embryos	1.0 —	*cm.* long.
Formation of Lachrymal Canals and Ducts, . .	1.8 —2.2	"
Formation of the Lachrymal Furrow, ...	2.1 —2.3	"
" " Eyebrows, ...	2.4 —3.0	"
" " Lachrymal gland, ...	2.8 —3.0	"
" " Harder's gland, ...	4.0 —	"
" " M. Orbicularis, ...	4.0 —4.5	"
Commencement of the closure of the palpebral fissure,	4.5 —5.0	"
Completion, ...	5.5 —6.0	"
Formation of Eyelashes, ...	6.0 —	"
" Meibomian glands, ...	8.5 —	"
" Conjunctiva Bulbi, ...	10.0—	"
" Sudorific glands, ...	14.0—	"
" Sebaceous glands, ...	16.0—	"
" Conjunctiva palp., ...	25.0—30.0	"
Separation of Lids, ...	40.0—47.0	"*

Description of Figures.

Fig. 1. Horizontal section through the eye of an embryo 2.3 *cm.* in length. The eye lies for the most part free. At *a* and *i* are to be seen the outer and inner divisions of the lachrymal furrow. Mag. 45.1.

Fig. 2. Sagittal section through the other eye of the same em-

* The smaller embryos were measured in their longest diameter. The larger ones from buttocks to front.

bryo. At *o* and *u* are the superior and inferior divisions of the furrow.

The fornix in vertical as well as in horizontal meridian lies behind the equator of the bulbus. In both of these figures the increase in the ectoderma is not to be well seen on account of the small magnifying power used. Enlarged 45 times.

Fig. 3. Sagittal section through the eye of a 4.7 *cm.* long embryo. The lids extend only to the margin of the cornea. At this time the closure of the lid commences.

The fornix now lies at the equator. Enlarged 45 times.

Fig. 4. At *a* is the eye of a 4 *cm.* embryo. The lids are scarcely to be seen, and are far apart; at *b* one of 4.7 *cm.*, and then the closure of the lids is seen commencing at the commissures. At *c* we have the eye of at 5 *cm.* embryo. A further development in the closure of the lids. Lids become much smaller.

They are connected by the suture, which spreads itself out like a membrane over the cornea.

The margin of the upper lid is strongly curved at its centre. That in the under lid is not quite great enough.

At *d* the eye of a 5.4 *cm.* embryo. The space between the lids is closed at the commissures by a suture, in the middle by an epithelial membrane. In the last can be seen a small round opening through which the cornea is visible.

The concavity of the margin of the upper lid is still quite perceptible, while the under lid runs more in a straight line.

All these magnified 6 diameters.

Fig. 5. Sagittal section through the eye of a 5.4 embryo. In this we see the epithelial membrane which connects the lids. Its elements stand perpendicular to the lids. Enlarged 45 diameters.

Fig. 6. Sagittal section of the same eye nearer the middle of the palpebral fissure. The margins are drawn strongly toward each other, but are still free. In both the fornix is near the attachment of the iris. 45 diameters enlarged.

Fig. 7. Sagittal section of a 6 *cm.* embryo. The lid fissure has just been closed, and the margins are everywhere connected by the suture. The fornix is at the corneal margin. Enlarged 45 diameters.

Fig. 8. Sagittal section through the lids of an 8.7 *cm.* embryo. The lashes appear in the form of shallow depressions filled with round cells. There is also a corresponding development in the mesoderma to be seen. Near the inner canthus of the lids a Meibo-

mian gland has commenced to form, and between the rete and the cells of the suture, there is a collection of small round cells, and simultaneously an increase in the mesoderma. Enlarged 140 diameters.

Fig. 9. Sagittal section through the lids of a 14 *cm.* embryo. The development of cilia and Meibomian glands is far advanced. They have the form of solid epithelial cylinders, surrounded by a distinct development in the mesoderma.

The small protuberances from the hair-bulbs represent the beginning of the sudorific glands. Enlarged 140 diameters.

Fig. 10. Meibomian gland in an embryo of 20 *cm.* in length. Enlarged 140 diameters.

Fig. 11. The formation of a hair in the vicinity of the lid margin, embryo 20 *cm.* long. There can be seen an epithelial tract passing through the epithelium toward the surface out of the hair tube. The cells of this tract are to be distinguished from the neighboring cells by their dimensions.

The beginning of a sebaceous gland can also be seen in the side of the hair-tube, and also a sudorific gland which has already become hollow. Enlarged 140 diameters.

Fig. 12. Formation of a hair near the margin of the lid in an embryo 26 *cm.* in length.

The cells of the epithelial tract just mentioned have undergone fatty degeneration, and the tract is thereby partially transformed into a passage filled with fat globules, and can be followed back as far as the sebaceous gland. Also magnified 140 diameters.

Fig. 13. Frontal section through the most anterior portion of the face of an embryo 18 *cm.* long. *n*, primitive nasal cavity; *an* external nasal protuberance; *o*, superior maxillary protuberance. *Tr*, the anterior end of the lachrymal groove, and its communication with the nasal cavity; *m*, cavity of the mouth. Magnified 140 diameters.

Fig. 14. Cross-section of the lachrymal groove in the same embryo near the middle of its course between the eye and the nose. 140 diameters.

Fig. 15. The formation of the two lachrymal ducts at *a* and *b*. Frontal section near the inner canthus of an embryo of 20 to 21 *mm.* at inner palpebral furrow. Mag. 140 diameters.

Fig. 16. Formation of lachrymal passage in an embryo 20 *mm.* long. *Tr*, the lachrymal groove which has become shallow; *ef*,

the epithelial cylinder produced by an increase in the ectoderma. Mag. 140 diameters.

Fig. 17. Formation of Harder's gland in an embryo 4.3 *cm.* in length.

At *f*, the opening of the same at the fornix into the lid groove. Mag. 230 diameters.

Fig. 18. Oblique section through the lachrymal canal of an embryo 8.7 *cm.* long, in the vicinity of the nasal opening. Mag. 230 diameters.

Fig. 19. Cross-section through the lachrymal passages of a 3.3 *cm.* embryo. Mag. 230 diameters.

Fig. 20. Cross-section of the lachrymal passage in an embryo 6.0 *cm.* long.

Fig. 21. Harder's gland in embryo 7.7 *cm.* long. Mag. 140 diameters.

Fig. 22. The lens in an embryo 10 *mm.* in length. Notice that the ectoderma is pushed in and forms a cavity which is filled with cells. Behind the lens a transparent mass free from cells, in which mass delicate fibres are seen. All magnified 230 diameters.

These figures have been drawn by Mr. Veith of Heidelberg, with his usual skill, without detailed directions on my part, and this fact fully counterbalances some small error in the histological relations of the parts.

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RARE FORM OF INTRA-OCULAR GROWTH, PROBABLY SYMPATHETIC.

By P. H. MULES.

Surgeon to the Manchester Eye Hospital, England.

MARY L., a broken-down cachectic-looking woman, attended the Manchester Eye Hospital on March 12, 1878, for incessant pain in the left eye. The right eye had been removed some three years previously for pain following an accident, but no history of its condition could be obtained. She was advised as to the removal of the remaining one, and she submitted in June the same year.

The globe was normal in size but of stony hardness, the cornea opaque ; commencing at the optic nerve sheath and running towards the cornea was a bulge in the sclera of the size of half a filbert. On making a section through the elevation in the long axis of the eyeball, and dividing it in halves, the globe was found as described below, and as Dr. Dreschfield of Manchester, Owens College, was good enough to examine the specimen for me, I will quote his description of its condition.

"The tumor which was given to me for examination consisted of the half of one eye, elongated section with lens attached, optic nerve and insertion not present in this half. The naked eye appearances were briefly as follows : The coats of the eye thickened, especially the sclera which near the optic nerve entrance was ½" in width. This thickened sclera had a distinct fibrous appearance, was hard and firm on section, and near the junction with the cornea had an almost cartilaginous appearance and was there cut with great difficulty. The retina seemed likewise thickened, and between the retina and sclera the choroid appeared as a narrow layer, owing to the thickened sclera the interior was very much

compressed, especially the posterior chamber, and the lens was opaque and in contact with the cornea. The ciliary body and the surrounding parts were of a finely granular appearance, tinged red and much thickened.

"Microscopic examination showed that the sclera consisted of fibrous tissue fibres and tissue corpuscles, and between the layers was found an accummulation of small cells with distinct nucleus and granular contents. The cells were arranged sometimes in a linear series, sometimes in larger masses, and filled the interstitial tissue of the sclera. They were found chiefly round the small arteries of which there were many in the sclera. They were not contained in distinct alveoli of a newly-formed stroma, but seemed more like a mass of extravasated cells between the layers of the sclera. In character, they in no way resembled epithelial cells, and therefore the whole could be looked upon as an inflammatory thickening, and not a form of cancer, such as scirrhus. Neither was the microscopic appearance like that of sarcoma, for there was too much areolar tissue, which was in fact the true scleral tissue.

"The retina looked when examined microscopically, to consist of nothing but bands of fibrous tissue, containing again an accumulation of cellular elements of exactly the same nature and of similar distribution as in the sclera section of the ciliary border, and the granular material surrounding it showed a mass of round cells with distinct nuclei, not unlike leucoytes, fibrous tissue and quantity of blood pigment. This mass seemed to be due to a chronic inflammatory process with extravasation of blood.

"I am therefore inclined to look upon the specimen as a case of slow chronic inflammatory thickening of the several coats of the eye with extravasation of blood at the border of the ciliary body."

It appears then, that this very unusual condition must be a form of sympathetic disease, all the more peculiar in that it commenced ten months after the removal of the first globe for pain, the woman stating that she was quite well for ten months, and able to do her usual household work and sew.

TWO CASES OF FOREIGN BODIES WITHIN THE EYE.

By H. KNAPP.

THE consequences of the entrance of foreign bodies into the eye, I trust, will never cease to attract the interest of the profession, and though the ordinary changes produced by them, viz., the acute (purulent) and the chronic (plastic) panophthalmitis are familiar to every experienced practitioner, there are always cases the unusual course of which excites the interest even of the expert specialist, by adding to the stock of his clinical experience and furnishing new practical suggestions. It is not without merit, and a chief object of journalism, to popularize remarkable facts which are only in the possession of a few. With this view, the following cases and remarks are unpretentiously offered to the reader without any bibliographical reference. As to the literature on foreign bodies within the eye, I take pleasure, however, in mentioning that an extensive work has just appeared in French, viz., "Traité Pratique et Clinique des Blessures du Globe de l'Oeil," par *A. Yvert.* Paris, 1880. It is an extensive treatise (759 pages) on the injuries and foreign bodies in the eye, and on sympathetic ophthalmia. The original observations were mostly collected at the clinique of Dr. Galezowski, whose assistant the author was.

CASE I.—*Successful extraction of a piece of metal, lain over a year in the sinus of the anterior chamber, and causing purulent irido-cyclitis.*

Hugh N., æt. 13, of New York, came to the dispensary of the N. Y. Ophthalmic and Aural Institute on Aug. 29, 1879, with the symptoms of circumscribed irido-cyclitis. He looked healthy and free from any constitutional taint. There was marked circumcorneal injection, more in the lower part than laterally, least in the upper part. The lower part of the iris was discolored and swollen. The pupil was small, sluggish and irregular, dilating but little on instillation of atropia. At the bottom of the anterior chamber there was an oblong, grayish-brown nodule, reaching with its pointed whitish apex to the transparent margin of the cornea, and penetrating with its body deeply into the sinus of the anterior chamber, where its other end was concealed from view. The vitreous was hazy, affording but a dull image of the central and upper parts of the background of the eye. The lower and anterior part of the vitreous chamber was occupied by a white patch, resting with its basis upon the ciliary body, close behind the equator of the lens, and sending a number of thread-like offshoots radiatingly into the vitreous. The lower part of the ciliary region was sensitive to the touch. The field of vision was contracted above. S. $\frac{10}{200}$.

My impression was that the inflammation was the result of a foreign body lodged in the lower anterior part of the eye; but the possibility of anything having entered the eye was denied by the boy, and his mother had never had reason to suspect such an occurrance. For a whole year, she stated, the eye had been red and painful every now and then, but got well again in one or a few days. The boy had never complained much until two weeks ago, when the eye was redder and more painful than usual. The last week the inflammation had subsided, but he was losing his sight. There was no scar or any opacity of the cornea discernable.

Under these conditions I advised antiphlogistic treatment, and pointed out, that if a foreign body lodged at the root of the iris, the suppuration might bring it to the surface, and make its extraction possible. For some weeks the inflammation continued slightly increasing, the point-like apex of the nodule in the anterior chamber developed into a well defined pustule, the pupil grew smaller and more adherent to the lens, the opacity of the vitreous in the lower ciliary region increased, sight failed more and more, yet the eye was only moderately painful, but its tension markedly diminished. I maintained my suspicion of the presence of a foreign body, regretting that there was no evidence of it in the history

of the case, otherwise I would not hesitate to make an attempt at removal of the foreign body which I believed to be at the bottom of the pustule in the sinus of the anterior chamber. I even stated that I was almost tempted to make an operation in search of a foreign body, since the eye was plainly on the way of being destroyed by the inflammation. Now the boy, who was not an ill-behaved child, and was kindly treated at home, confessed to his mother that more than a year ago he had been striking gun-caps with a hammer, when he had felt that something flew against his eye, but having experienced no pain at the time he had not said anything about it. At that time, however, the above-mentioned attacks of transient inflammations had begun. As soon as the mother brought me that information, I hesitated no longer in performing the operation.

October 11, 1879. I made with a narrow-bladed cataract knife a small opening at the lower part of the sclero-corneal junction, and dilated it with stabismus scissors on both sides so as not to interfere with the pustule. I first introduced the curved hollow foreign-body hook into the anterior chamber with the concavity upward, and passed its point across the pustule, hoping that the enclosed foreign body might fall into the groove of the instrument and be extracted. The attempt failed, and no foreign body was recognizable. I then introduced the hook again, and, the concavity looking downward, passed the point deeply through the sinus of the anterior chamber from one side to the other. In withdrawing the instrument a small black body was brought out in its concavity and stripped off by the outer edge of the corneal incision, from where it was taken up with a pair of forceps. It was hard, about 2 *mm.* in its greatest dimension, had irregular sharp edges, and showed a metalic lustre under the microscope. Whether it was iron or copper we did not examine, since we wished to preserve it in the condition in which it had been extracted.

A small prolapse of iris was immediately replaced, and eserine instilled. The patient made a very satisfactory recovery, there being hardly any reaction from the wound. In fact the boy felt better immediately after the operation. He slept well and had lost all the pain in his eye. The anterior chamber assumed its normal depth. The pupil grew slightly oval, its lower end drawn downward. This was no doubt the result of the previous inflammation and the puckering of the lower part of the iris during and

immediately after the operation, for there was no anterior synechia. The edges of the pupil became regular, all the adhesions disappeared, but the pupil was never completly dilated by atropine. The vitreous cleared up steadily and the field of vision increased gradually to its natural limit. The tension of the eyeball grew normal in one week, and no tenderness on pressure remained. At present, seven weeks after the operation, the whole fundus can be clearly seen with the ophthalmoscope. It is clear in the central and upper parts, but somewhat veiled in the lower, owing not so much to opacities in the vitreous, as to irregular deposits on both surfaces of the crystalline lens, also to some opacities in the lower part of its substance. F. complete; Tn; S. $\frac{8}{10}$. The other eye had never shown any symptoms of irritation.

In regard to the operative procedure I may refer to a former paper,* and this case may serve as an illustration to the remarks made on the removal of foreign bodies from the sinus of the anterior chamber. Though in such cases I recommended, as a rule, to remove the iris which had been involved, on account of the dangers incident to peripheric anterior synechiae, I succeeded in this instance to remove the foreign body without mutilating the iris and without causing adhesions, demonstrating the old rule, that operative procedures should be modified according to circumstances. In cases in which the section is very peripheric, the operation more or less laborious, especially if the iris has been bruised and after its reduction falls back into the wound, an iridectomy should never be omitted.

Nothing varies so much as the length of time during which foreign bodies may lodge within the eye without doing mischief. I have seen cases—and these are not very rare—where intense suppurative panophthalmitis was manifest on the second or third day, and when I removed such eyes I commonly found a piece of metal, stone or glass situated in or upon the ciliary body. A thin coat of white pus was not only around the extraneous substance, but covered the inner surface of the corona ciliaris more or less uniformly, whereas the vitreous was still toler-

* The Removal of Foreign Bodies from the Interior of the Eye. These Arch. vii. p. 311–346.

ably clear and in the retina venous congestion only was present. One or a few days later we find besides the patch of pus around the foreign body, and the purulent coating of the ciliary ligament, the well-known purulent streaky conditions of the vitreous, which is the precursor of total suppuration. The chronic plastic irido-choroiditis or irido-cyclitis, the most frequent form of inflammation produced by foreign bodies within the eye, is too well known to be illustrated by new cases, however important and interesting some of them may appear. But of cases where foreign bodies long lay quiet in the eye, and then suddenly produced irritation necessitating the removal of the globe, I have recently seen an example which may be worth reporting in this place, though the globe was presented to the N. Y. Pathological Society seven months ago.

Case 2.—A. L., æt. 27, of Newark, N. J. In December, 1872, a piece of metal struck his left eye, perforated the cornea, and wounded the iris and lens. A few days later he came to see me, having a great deal of pain in the eye. There was traumatic cataract, and iris lay in the corneal wound. The foreign body was invisible. Perception of light, good. A defect of F. not clearly demonstrable. I made an upward iridectomy, and extracted the greater part of the lens on September 23, 1872. No great reaction followed upon the operation. Some hemorrhage into the anterior chamber ensued, and a ring of blood-vessels formed around the rent in the anterior capsule. In two weeks the patient was discharged.

During the next six years the eye was several times inflamed, but only slightly, and never longer than a few days. On April 11, 1879, however, a severe inflammation set in, with nightly exacerbations of pain, lachrymation and photophobia. Dr. Kipp ordered six leeches to the temple and referred the patient to me. I found intense circumcorneal injection, the cornea of normal dimension, some opacity and a superficial ulcer in its centre, the iris yellowish discolored, one limb of the coloboma adherent to the corneal scar, a pseudo-membrane in the pupil attached to the iris on one side. Size and tension of globe normal, perception of light in every direction. There was lachrymation and photophobia in the fellow eye, but its pupil moved promptly, and fully dilated by instillations of atropine.

Supposing that a foreign body was still in the eye, I enucleated the globe on April 14th. Recovery perfect. Patient discharged April 19th.

The globe was opened by an equatorial section immediately after the enucleation. The anterior part of the vitreous was liquid, the posterior normal. Retina and choroid in position. Optic nerve and yellow spot normal. About 8 *mm.* from optic disk in the temporal part of the horizontal equator there was in the retina a whitish-gray circumscribed, distinctly-raised scar of 4 *mm.* in length and 2 *mm.* in breadth, and above it a depression which on its upper and external borders was surrounded by black pigment. In the lower part of the eye, on the junction of the pars plicata and non-plicata of the ciliary body, there was an oblong piece of metal, 3 *mm.* in length, covered with a thin layer of fibrous tissue and scarcely fastened to the place upon which it rested. The anterior parts of the eyeball showed the changes mentioned before the enucleation. There was no suppuration in the globe. The condition was that of recent plastic irido-cyclitis.

I think I am not mistaken in assuming that the piece of metal which struck the eye six years previously, penetrated the cornea, iris, lens and vitreous, and remained in the retina at the place where the above-described depression, surrounded by a wall of connective tissue and pigment, was found. In this place it had lain encapsulated for over six years, but lately had detached itself, fallen to the bottom of the eye where it was found on examination of the globe after the enucleation. Though the changes in the anterior half of the eyeball may explain the occurrence of the slight and transient inflammations which had several times been observed in the course of these six years, I believe that the last and severe attack was produced by the falling of the foreign body on the ciliary ligament. I cannot imagine that the foreign body could have lain there for a longer time without producing inflammatory changes, in particular plastic cyclitis, which, at best, would have led to its encapsulation. Instead of that it lay there quite loose, whereas on the back-

ground of the eye the above-described depression, surrounded by a wall of connective tissue, seemed to answer completely to the requirements of having been the receptacle of the foreign body which was found on the bottom of the eye. Foreign bodies encapsulated in the background of the eye, have a few times been noticed with the ophthalmoscope for years, then they detached themselves, dropped to the bottom of the eye, and produced violent inflammation.

A CASE OF PARESIS OF THE OCULAR MUSCLES FROM COAL-GAS POISONING.

By H. KNAPP.

THE following case seems to be worthy of publication, on account of its etiological interest.

Mr. J. R. W., æt. 27, of Newark, N. J., was sent to me by the kindness of Dr. Max Küchler (who at that time was ill), on February 8, 1879. Two months previously the heater in his residence had been out of repair, and remained defective over night. He inhaled the air from this heater the whole night. Next morning he was found unconscious, and though soon roused to his senses, for ten days he was so severely ill that his life was believed in danger. The cerebral symptoms, headache, stupor, and the sensation of general debility then disappeared, and only ocular symptoms remained, of which Dr. Küchler wrote me, that, at the beginning, there had been a paresis of the six muscles of each eye, causing a certain degree of stiffness and protrusion—buphthalmus—in both eyes. Besides, there had been marked presbyopia, requiring the use of convex glasses in reading. The patient had suffered also from photophobia. When he came to see me he stated that, during the first weeks after the poisoning, there had been a slow improvement, but that during the last six weeks the condition of his eyes had remained stationary. I found in his right eye S. $\frac{20}{20}$, with M. $\frac{1}{48}$; in the left, S. $\frac{20}{30}$, E.; F. complete in both. Both his eyeballs were slightly protruding. When he looked at an object above the horizon, both upper lids were raised to their normal height, whereas the elevation of the eyeballs was below the normal. He conspicuously presented the phenomenon

of dissociation between the elevators of the upper lids and the elevators of the eyes, which v. Graefe first described in Graves' disease. The patient stated that in the first weeks after the poisoning, he had been totally unable to raise his eyes. At the beginning there had been very marked strabismus divergens. At his first visit to me, there was only insufficiency of the internal recti. His pupils were medium-sized, movable. The background of the eye showed nothing abnormal. There was paresis of accommodation, since he held his books very far, and could not read fine type. With convex glasses $\frac{1}{14}$, and even $\frac{1}{36}$, he could, however, easily read it, and at the ordinary distance. He still had headache every now and then, but his intellect was undisturbed.

Supposing that by time the effects of the poisoning would gradually disappear, I advised him to take no medicines, yet have galvanism applied to his eyes and head. He did this for eleven days without any improvement. The insufficiency was even more pronounced, and in reading his right eye flew outward. This was not the case when I put a prism of 3°, basis inward, combined with a weak convex glass, before each eye. I therefore ordered him such glasses, and advised him to continue the electricity and take Turkish baths. For the next four weeks he found relief from his glasses in reading, but could not wear them when looking at the distance. Then the insufficiency increased, the double images annoyed him more and more, and when, two months and a half after I had first seen him, *i.e.*, four months and a half after the poisoning, the insufficiency had reached such a degree that there was marked strabismus divergens almost constantly, binocular fixation being sustained only for a few seconds at the time, I gave up the hope of a restoration of the muscular balance without an operation, and made him a full tenotomy of the right external rectus. The operation reëstablished binocular fixation, diminished his discomfort, but left a high degree of insufficiency. Since, in the course of four weeks, this showed no tendency to diminish, and there was troublesome asthenopia, even with his prismatic glasses, I divided also his left external rectus. He felt more comfortable after it; the diplopia occurred but rarely, and the asthenopia had diminished. In the next four weeks, however, the paresis, both of the internal and superior recti, increased again; the dynamic divergence for a distant object of fixation being 4 *mm.* again, and when the upper lids were raised, the corneæ lagged conspicuously behind. This was by the end of June, and

the atmosphere of the city had become oppressive. I therefore advised him to spend the hot months in the woods of our northern mountain regions. This he did, and returned materially improved. Dynamic divergence for distance was only 2 *mm.*, and he saw double only at the lateral limits of his field of fixation The improvement has still continued, since he now, November 24, 1879, sees double only at the extreme right. His dynamic divergence is 1 *mm.* for the distance, and only little greater near by. His binocular fixation is steady from 10 *mm.* to infinite distance. His paresis of accommodation has also improved, and only every now and then he uses slight convex glasses in reading. The dissociation between the elevators of the lids and the elevators of the eyes is still present, though he can raise the eyeballs apparently to the normal height. The interior of his eyes is healthy. Neither at present, nor at any time as long as the patient was under my care, has any abnormity in the background of the eyes, *e.g.* congestion, anemia or œdema of the disc and retina been noticed, and his acuteness of vision never was diminished. The patient is at present in a satisfactory condition, and in a fair way toward complete recovery.

So far as I have perused the literature at my disposal, I have seen no mention made of paralytic affections of the ocular muscles from coal-gas poisoning. They are not unknown, however, in other parts of the body, as the following passage taken from Grisolle's *Pathologie Interne* (5me édition, t. i, p. 57) demonstrates: "Ou cite des individus qui, après être restés longtemps souffrants, conservent toute leur vie une grande tendance aux congestions cérébrales; d'autres demeurent infirmes, ayant guelques graves lésion du côté des fonctions locomotrices, de la sensibilité ou de l'intelligence. Un médecin distingué, M. Bourdon, a étudié dans sa thèse inaugurale (1844) la paralysie qui survient quelquefois à la suite de l'empoisonnement par la vapeur du charbon; elle doit s'expliquer par une congestion sanguine ou par quelques foyers apoplectiques d'un petit volume; disons toutefois que c'est là un accident rare, et dans tous les cas où nous l'avons constaté il n'a eu qu'une durée fort courte."

In our case the paralysis was noticed in the ocular muscles

only. According to the statement of Dr. M. Küchler (the son of the late well-known oculist of Darmstadt), who treated the patient at the beginning, it had affected all the muscles of both eyes. In the course of two months a partial restoration had taken place, and the paresis was manifest only in the internal and superior recti, the sphincter of the pupil, and the ciliary muscle. In these, however, it showed a very slight tendency of recovery, and the development of a paralytic divergent strabismus rendered the tenotomy of both external recti necessary. The treatment with electricity and Turkish baths had no perceptible effect on his condition, but traveling in the woods and mountains seemed to have done him a great deal of good.

A CASE OF SEVERE IRITIS AND GLAUCOMA, FOLLOWING IRIDENCLEISIS.

By H. KNAPP.

UP to the year 1867, I made about forty operations of iridodesis. One eye, operated on for kerato-conus by that method, was lost. Since other cases of failure were reported at the time, I never resorted to that operation again. Yet the advantages of a small, pear-shaped pupil over a broad coloboma of the iris being so marked, I always endeavored to make the artificial pupil for optical purposes as small as I could, and was not sorry or much concerned, if one or both limbs of the coloboma remained adherent to the corneal scar. I always cut every particle of iris protruding outside clean off, but when the outer wound was free and the lips applied well to each other, I took no particular trouble to remove the corners of the sphincter or a part of the limb of the coloboma from the canal of the wound if it happened there to be engaged. Thus without specially aiming at iridencleisis, I took less care in clearing the track, and, in paticular, the corners of the corneal section from iris lying in them than I do in operations for glaucoma and cataract. It was just in such, as it were, impure operations that I obtained the best optical results. When some inflammatory irritation followed the operation for a few weeks, its effect was only to draw the pupil toward the periphery, and by covering more of the central opacity, to contribute a great deal to the sharpness of sight and the comfort of the patient. All this is well-known to the expert, as is also the fact that

there is a drawback inherent to these operations. When a precedure, from its nature, is liable to be followed by irritative reaction, the irritation will occasionally, *i.e.* under particularly favorably conditions, surpass the limit of innocuity, and permanently damage or destroy the organ. That this is the case with all methods in which iris may be left in the wound, seems to be generally acknowledged, and a certain number of cases have been published in support of this statement. In my own experience no case has so forcibly demonstrated the truth of this statement as the one which, for its impressiveness, I beg leave here to communicate.

B. L., æt. 34, was admitted to the N. Y. Ophthalmic and Aural Institute, April 15, 1878. The moderately increased size of the head of the patient indicated former hydrocephalus. His intellect also was weak. He had had convulsions when a child. His sight had always been impaired. In both eyes there was a moderately large zonular cataract. When the pupils were dilated S. was $\frac{20}{200}$ in the left, and $\frac{15}{200}$ in the right eye, before dilitation his sight varied from $\frac{4}{200}$ to $\frac{15}{200}$ according to the influence of light on his pupils. In bright daylight he was helpless. Through the transparent periphery of the lens a healthy background was seen with the ophthalmoscope.

I made a narrow opening into the inner lower part of the limbus conjunctivæ near the transparent corneal margin of the left eye. A small portion of iris was caught with forceps, drawn out of the wound, and cut off, but the corners of the sphincter were left in the wound, without, however, being noticeable outside. Healing undisturbed. A minute incarceration of iris showed itself. Pupil small, beautifully pear-shaped, perfectly movable. Patient discharged six days after the operation. S. $\frac{20}{15}$.

Two weeks later I made an iridectomy on the the right eye. The sphincter had escaped cutting. A blunt hook was introduced, and the sphincter apparently torn. The wound was clean. No reaction followed. Two days later the sphincter was seen undivided in its natural position, and there was besides the natural pupil a very clear quadrangular artificial one. Thus unintentionally a shape of pupil was obtained which B. A. Pope recommends as the best in zonular cataract.* Healing undisturbed. Patient discharged six days after operation with S. $\frac{20}{50}$. Both pupils in

* See ARCH. OF OPHTH. AND OTOL., ii, 1, 87.

their kind were so beautiful and the visual result was so satisfactory, that I took particular pleasure in demonstrating the case to the class of students at the Institute.

Unfortunately the history of the case does not end here. Though the patient had been discharged without any reaction after the operation, three days later he returned with a plastic iritis in his right eye, the last operated on. The day of his discharge he had exposed himself to the rain for several hours. His lodgings had been poor and he had been without attendance. There were adhesions, and the iris around the coloboma was discolored and swollen. Leeches and atropine produced temporary improvement, after which the synechiæ became more numerous, the incarcerated iris in the other eye formed a small protrusion, and iritis set in in that eye also. For a month the iritis continued in both eyes with varying intensity. The antiphogistic treatment was as strict as possible; atropine, darkness, rest in bed, leeches, hydrargyrum until salivation occurred. In spite of all this the adhesions increased in both eyes. In the second and third months, glaucomatous attacks set in, first in the right, then also in the left. Leeches and eserine reduced the highly increased tension in each attack. The pupils were covered by false membranes, the iris and lens were pushed forward in both eyes, and sight was reduced to from $\frac{1}{200}$ to $\frac{1}{300}$. At the beginning of the fourth month Dr. Pooley, during my absence in Europe, abscised the iris prolapse in the left eye; no reaction followed. Then a condition of chronic iritis with occasional increase of tension was present for some months more, the right eye always being the most severely affected. A low degree of crater-shaped pupil had developed in both eyes, less marked in the left than in the right. When the field of vision had become contracted on the nasal side, I extracted, January 7, 1879, the lens through the upper section combined with a broad iridectomy. Some cortex remained in the eye. The reaction was very moderate, yet the coloboma closed again, whereas the center of the pupil was occupied by the false membrane. The eye after the extraction caused little annoyance, but its tension continued increased for a long time. The tension in the left eye had become normal again, the visual field complete, and the inflammation had disappeared. He still could count fingers with it at 1′. During the summer he went to the country and was free from pain.

In autumn, 1879, he returned. The condition of his eyes was

unchanged. I performed an iridectomy in the upper part of the left eye, opposite the old artificial pupil which had closed. The tissue of the iris was frail, but not adherent to the lens. There was moderate bleeding in the anterior chamber. The operation was followed by no reaction worth mentioning, and resulted in a small clear pupil above the edge of the zonular cataract. At present, three months later, the tension and visual field in that eye are normal. There has been no irritation since; the patient can count fingers at a distance of 10′, and read Jaeger 16. In the other (right) eye there is only quantitative perception of light in the outer half of the visual field.

Concluding Remarks: The foregoing case has concerned me more than a thousand others. To see an iridectomy in two eyes which were affected with zonular cataract, but otherwise healthy, followed by chronic irido-cyclitis and consecutive glaucoma, virtually destroying the sight in one, and impairing it very seriously in the other, could not have occurred without some dangerous condition caused by the operation. The dangerous condition was the incarceration of iris in the eye first operated on, and the adhesion of the iris to the corneal scar (anterior synechia) in the other. The patient was discharged at the ordinary time, six days after the iridectomy, the reaction from the operation having apparently disappeared.

The above case teaches, among others, two lessons: (1) *A clean and simple iridectomy furnishes the safest artificial pupil,* and no optical advantage to be gained by any modification of iridectomy can justify an operator to take a greater risk. (2) *Patients should not be discharged "cured" too early.* Had the above patient been kept longer in the hospital, iritis would probably not have occurred, and had I known that he was going to expose himself as he did, I would not have consented to his discharge.

FOUR CASES OF COLOBOMA OF THE SHEATH OF THE OPTIC NERVE, WITHOUT ADDITIONAL FISSURE IN THE UVEAL TRACT.

By Dr. A. NIEDEN, of Bochum.

Translated by James A. Spalding, M.D., Portland, Me.

(*With Four Wood-cuts.*)

AS I can hardly expect any further opportunities of observing additional cases of this very rare anomaly, I shall delay no longer the publication of the four cases that have come under my observation, whereby the number of cases hitherto reported is increased more than two-fold.* In order to make the several ophthalmoscopic pictures more clear, I have made sketches of all the cases, which are perfect copies from nature in the various details, but for the imperfection of which I beg indulgence, on account of my lack of skill in drawing.

The four examples belong to three persons, one of whom, having the same anomaly in both eyes (Figs. 1 and 2), I had the opportunity of examining for a long time at Prof. Sämisch's clinique at Bonn, who kindly permitted me to publish it. Of the others, (Figs. 3 and 4), which I discovered in the clinique of the German Hospital in London, one (Fig. 3), had already been seen ten years before by Dr. Bäumler (at that time on the staff of the hospital), but was lost again in the tumult of London life, and only fell under my care by the merest accident. The third was referred to me by the kindness of Dr. H. Pagenstecher during his sojourn in London.

* 1. v. Ammon, Arch. für Ophth., Bd. iv, 1, p. 44, et seq. 2. Liebreich Arch. für Ophth., Bd. v, 2, p. 246, and Atlas of Ophthalmoscopy, Plate XII Fig. 4. 3. v. Wecker, Traité de Maladies du fond de l' œil, pag. 207.

The Bonn patient, Gerhardt W., æt. 9, complains of long standing inflammation of the eyes, which, now better, now worse, had gradually injured his sight very much, and in the last few weeks had completely prevented the use of his left eye. The parents said, that the boy had suffered from weak eyes since infancy, although they were not inflamed at first, and that they for many years had oscillated constantly so soon as the boy looked attentively, at any object. Still, he had gone to school and learned to read, but he could not see clearly for any length of time or by artificial light. At the age of 8, the eyes inflamed for the first time, grew better "of themselves" in a few weeks, and small spots were left on both, which made it very difficult for him to see at school. In the last few weeks the inflammation and swelling of the eyelids had increased, there was great dread of light, and then the parents sought help. Otherwise the child was quite well.

The patient is delicate for his age, looks lymphatic and scrofulous, and has blonde hair and blue irides. He has violent blepharospasm and excessive dread of light, which are due to a florid granular conjunctivitis. In both eyes the conjunctiva is so much swollen, that it quite covers the granulations. Both eyeballs are normal in shape, but of small dimensions. The right cornea shows some small central maculæ, the left cornea an adherent leucoma downward. The depth of both anterior chambers is relatively normal, and the color of the iris bluish, the striation less distinct in the lower part. The inner edge of the pupil is regular, leaving aside the deformity caused in the left eye by the leucoma. The pupil is moderately dilated, reacts well to incident light and dilates *ad max.* after atropine.

Lateral illumination shows the lens to be transparent, but the eyes being very sensitive, an ophthalmoscopic examination was not undertaken. During the examination and while making attempts at fixation, both globes rotate regularly and very rapidly from right to left about the vertical axis, and only come to rest for a short time when the patient lets his gaze wander off into the distance. The patient has complete control over the voluntary movements. There was also present a concomitant squint of the left eye, with a secondary deviation of $2\frac{1}{2}''$

The patient thus offered an example of the most varying external diseases in both eyes. No wonder then that a pathological anomaly of the interior of the eye was not also suspected. The granular conjunctivitis was enough to explain the scars on the

cornea, these again could be regarded as satisfactory cause of the nystagmus, disregarding the statement that it had existed before the primary inflammation. Finally, the broad leucoma of the left eye could serve to bring the strabismus convergens of this eye into causal connection with the effort to exclude it wholly from the act of vision. The eyes being much irritated, it was impossible to test the vision.

Only a few months later when the trachoma had yielded, and the corneal opacity cleared up noticeably, an ophthalmoscopic examination was undertaken, which after previous instillation of atropine, gave a moderately clear image of the fundus.

Both eyes were found to be H., about $\frac{1}{20}$. The refracting media were perfectly clear, and the choroid and retina normal in color and structure. The vessels of the choroid were very distinct owing to lack of pigment. But the image of the optic disc in both eyes was therefore all the more extraordinary. The papilla of the right eye (Fig. 1), was nearly twice as large in diameter as the

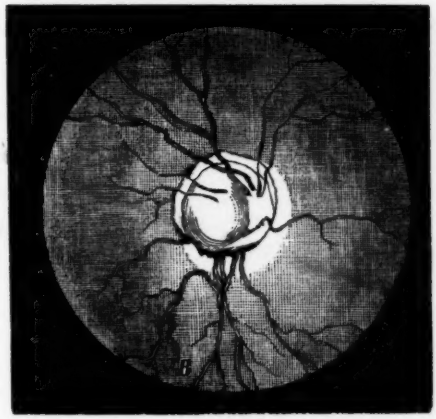


FIG. 1.

normal. It was irregularly oval with its longest axis vertical, a broad base and very sharply set off against the rest of the fundus oculi. The outer and lower borders were marked by abundant collections of pigment, while the scleral, choroidal, and nerve borders coincided along the whole base. The inner edge of the disc was pretty free from pigment, and here as well as $\frac{2}{3}$ of the circumference of the papilla on the upper segment, the

white scleral rings moved far away from the papilla. The scleral ring appeared broadest outward and upward, and passed inward into the choroidal zone, just before the beginning of the pigment border. The disc was bluish white and very brilliant, with a few grayish patches in its upper portion. The lower half was very white, and without striæ. But the vessels showed still greater abnormities. The venous and arterial branches coursing upward, took their origin by pairs in the centre of the papilla a little towards its inner edge, and then passed out normally over the scleral ring, the veins outward and upward, the arteries inward and upward. At the lower border of the papilla on the contrary, a pair of arteries and veins started up from the pigment ring, bent in a dark red curve over the edge of the papilla and then passed off regularly, branching over the retina.

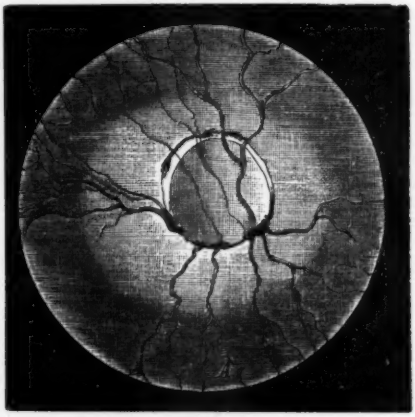


FIG. 2.

In the same way, a small artery started up from the lower and outer edge, and passed downward and outward upon the retina. The arteries and veins were normal, without pulsation or abnormal distribution on the retina. No irregularities of pigment or fissures in the choroid were discoverable in the fundus; T. unaltered.

It was much more difficult to examine the left eye, both on account of the leucoma as well as the more violent nystagmus. This eye having been destroyed six months later by a perforating ulcer resulting in an adherent leucoma, I have to refer to my notes of the first examinations, which show about the same state of the

papilla as in the right eye. The papilla was about 2½–3 times larger than normal; in color and borders, just like the right. The excavation was however still deeper, and the vessels originated near the lower excavated edge, even those which ran upwards; consequently they had to take an extended course upon the disc, and were denoted by a pallid color which gradually increased in intensity upward. The vessels were more abundant than in the other eye; those running downward, rose up from the pigment, curved sharply around and were distributed normally over the retina. The branches of the choroidal vessels were also easily to be followed to the periphery on account of the moderate pigmentation, and no fissure or alteration in the pigment was discoverable at any spot in the choroid.

H. being corrected gives *R. E.:* S.=$\frac{10}{10}$ Sn., and J. 5 fluently at 6′. F. shows a defect in both upper quadrants, and in its centre a moderate blur, corresponding to the central cloudiness of the cornea. *L. E.*, central amblyopia: J. 20 with stenopæic slit, and fingers at 2′. F. not measurable on account of leucoma and nystagmus, but seems to have a defect upward.

If asked to explain the pictures of these optic nerves, we have before us an optic disk about twice as large as a normal optic-nerve papilla, stretched downward and losing here its curved edge which is extended into a more or less straight line. The surface of the disk has also yielded downward and backward, as we can recognize from the color and course of the vessels, and exhibits the picture of a deep and even excavation from the bottom of which the lower retinal vessels start forward, invisible to the observer's eye and become visible first at the lower edge. The scleral and choroidal rings are united into a single line. At first glance the image reminds us of the one drawn by Liebreich* and described by him as coloboma of the optic disk.

The nystagmus observed by the parents in very early youth, and *before* the inflammatory affection of the eyes, leads us to suppose that we have to deal with a congenital affection. This view is supported by the ophthalmoscopic examination, the abnormal size of the papillæ, the displacement of their surfaces, and finally the results of visual

*l. c., Fig. 4.

tests and examinations of F., which do not allow us to assume a pathological formation. Moreover, the image corresponds exactly to what embryology teaches us about the early stages in the development of the optic nerve. If at the period when the optic nerve still shows a furrow close to its entrance into the sclera, there has ensued a disturbance of nutrition at the edges of the furrow which should naturally unite, and through which the central vessels are to be led as through a transition-canal to the retina, then the furrow cannot close normally. The union of the optic nerve with the posterior coat of the globe can therefore not take place in a circular line, but in a bow-shaped line opening downward. Moreover this abnormal formation encroaches still further upon the development of the contents of the furrow, upon the nerve-marrow forming the conduit of the central vessels, and hence the surface of the disk must slope downward and backward, and a defect of the nerve fibres must eventually be present in lower part of the retina.

As we have just seen, the state of the parts concerned in our case agrees fully with this theoretical reasoning.

In the diagnosis of a congenital coloboma of the optic nerve disk, I was moreover much more confirmed, when I again found the case observed years before by Dr. Bäumler, which showed coloboma of the iris, choroid, and retina of the *left* eye, and the identical image of the *right* papilla, as before described, without further fissure of the uveal tract.

Mrs. K., a Polish Jewess, æt. 25, has suffered from nystagmus since her youth, so that she cannot look steadily at any object without noticing the trembling.

The patient can tell us nothing of her vision in childhood, since she cannot read. The globes revolve regularly about their vertical axis, and the movements grow much more rapid when she attempts fixation. In this endeavor the *left* eye deviates at once, and concomitant divergent stratismus ensues as a result of great insufficiency of the internal rectus.

The globes externally are normal, only a pear-shaped defect in the *left* iris is at once noticeable. The iris is brown and radi-

ates evenly. At the free edges of the coloboma of the iris, the uvea is crumpled slightly inward along the fissure.

Ophthalmoscopic illumination shows punctate opacities on the posterior capsule. The lens is transparent, not pear-shaped, and its edge is plainly visible at the lower edge of the coloboma.

The fissure then extends to the ciliary body, choroid and retina, embracing the optic disc and passing a little above the edge of the papilla which is clearly set off from the glittering white surface of the coloboma by its grayish-red tint, and has a triangular or rather rhomboidal outline. There is no perceptible difference of level between the surface of the papilla and retina.

The glittering portion of the choroidal defect is divided into halves by a tendinous cord (much resembling a raphe) running from the point of the papilla to the periphery. The choroidal defect is overrun with numerous small and tortuous blood-vessels. S.= fingers at 16′, and only so much, when the outstretched hand at this distance is held far below horizontal. F. is difficult to determine owing to the patient's incapacity, but we could pretty

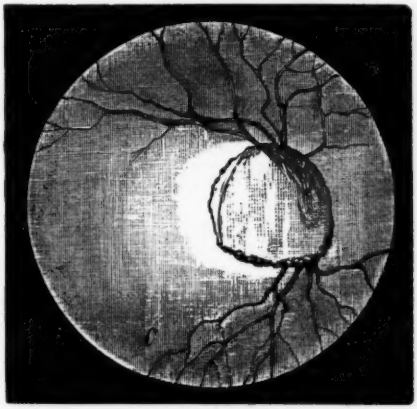


FIG. 3.

clearly determine a defect in the upper-outer quadrant; T. normal.

The *right* eye is externally normal. The nystagmus being present in about the same degree as in the left, there is about the same extent of quivering motion. There is no defect in the iris or anomaly of color in its lower half. The situation, size, and re-

action of the pupil are normal, and the refracting media clear. The choroid is normal in expansion, color, and vascularization. The optic disc (Fig. 3) is about 2–3 times as large as normal; its borders are sharply defined, and at the inner edge the choroidal border has retreated, so that the white sclera is seen. The lower edge of the papilla is angular and bordered by thick masses of pigment, which are also seen at the upper choroidal border of the papilla. The color of the optic disc is bluish-white below, and outward the delicate gray meshes of lamina cribrosa appear. The vessels as a whole arise at the lower part of the papilla; those running *upward* are very indistinct when I accommodate for the level of the retina, and only appear distinct at the upper edge of the optic disk. Beyond the disk they are distributed normally over the retina. The vessels of the *lower* retinal regions, however, start up suddenly in the midst of the lower masses of pigment, bend around, and run by pairs, arteries and veins, through the retina. There is no raphe or other abnormity in the lower quadrants of the retina and choroid. S.=⅓—½, as Snellen × × ×, on the tables for those unable to read, is distinguished moderately well at 10′. On the astigmatism test-table, the patient sees the two middle stripes most distinctly. The ophthalmoscope shows slight H., with astigmatic flattening in the horizontal meridian; but a more accurate examination with glasses is not possible. No demonstrable defect in F. in this eye; T. is normal.

We have here, again, a case of disproportional size and irregular shape of the papilla, a sunken surface of the disc, and vessels concealed in the bottom of the excavation without further anomaly in the membranes of the eye. If we recall our remarks on the process of development of the optic disc and its contents, we find a complete analogy with the first case. In the present case moreover we can so much the less doubt that we are right in assuming an anomaly by arrest of development, as in the other eye of the patient which is affected with coloboma of the whole uveal tract and retina, nature has pointed out to us that disturbances in the formation of the eyes, must have occurred in congenital life.

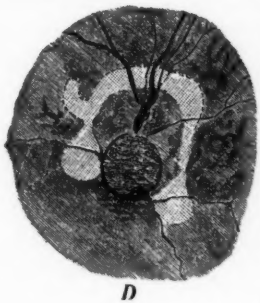
The fourth case is that of a patient who first sought advice at

Moorfield's Hospital, but being frightened by the long examination of the surgeons of so rare a case as hers, she withdrew from further observation, and I only saw her again by the kindness of Dr. H. Pagenstecher, who gave me her address.

Miss J. S., æt. 19, a seamstress, says she remembers her mother having said, that in the first days of her life, her left eye would not open; that it remained closed for some weeks, and finally was discovered to be smaller than the right eye. The patient said that formerly she used to see much better with this eye than at present, and that she lost the sight gradually. She has never had any annoyance from this eye, and it has never influenced the vision of the other.

At the first glance we notice that the left globe is much smaller than the right, and an oil painting of the patient hanging in her chamber proves that the microphthalmus must have been present in her earliest childhood. The whole orbit and the lids are smaller, the globe deviates about 3 *mm.* inward, when she looks steadily, but all its movements are normal, and there is no nystagmus.

The cornea and refracting media are clear; iris, pupil and choroid normal. The eye is highly myopic. In the erect image, the papilla is normal in size, reddish-gray, and clearly set off from the surrounding white scleral ring, and lies mostly on a level with the retina. In the whole circumference of the optic disc, the choroidal border, distinguished by delicate pigment-granules, recedes from the border of the nerve, and only unites with it at the lower border, which is denoted by a thick line of pigment. (See Fig. 4.) The upper part of the surface of the disc is normal, but the lower part, from the middle of the papilla downward, is occupied by a dark-blue shining membrane, forming numerous small horizontal folds. It is oval in shape, and by varying accommodation of the observer's eye, is seen to be a *deep excavation of the nerve at this spot*, bounded below by the black pigment ring of the lower choroidal border. The retinal vessels emerge from the middle of the papilla; the upper ones tortuous on the



D

FIG. 4.

disc itself, running vertically upward, pass the scleral border without bending, and branch out over the retina. The lower arterial and venous trunks also originate in the middle of the papilla, encircle about a quarter of the excavation, then disappear suddenly, re-appear on the outer side of the lower border of pigment, where by their corresponding size and calibre, they can be identified as the continuations of the vessels that disappeared. In the inverted image also, the parallactic displacement shows distinctly that the vessel at the spot concerned dips down into the bottom of the excavation, crosses in its further course an atrophic patch of retina and choroid, and finally branches normally over the retina.

A small arterial twig arises in the same way near the venous trunk from a heap of pigment on the inner lower edge, and runs obliquely inward. The choroid is normally developed, and exhibits two atrophic patches inward and one outward, where the bluish sclera shines through. But the vessels running over them, do not show differences in level. The retina on the outer side of the papilla, admits of the choroidal vessels plainly to be seen. The visual test shows a high degree of amblyopia; 19 Sn. at 6″; fingers at 5′, when the globe is turned excessively inward. F. shows a defect in the inner-upper quadrant, which reaches down to the centre of the point of fixation, and from there extends about 45° upward, outward, and inward.

S. in the right eye is perfectly normal, as is also its ophthalmoscopical condition.

We have, then, before us, an optic disc occupied in its whole lower half by a deep, oval sinus, and sharply defined from the normal borders of the papilla. The vessels of the lower portion are pushed back, *i.e.*, received into the excavation, and only re-appear when passing into the retina.

At the same time we have a microphthalmic globe, highly myopic, in which a few atrophic patches of choroid show that secondary changes have occurred.

My idea of the case is, that on the originally constructed microphthalmic globe, the place where the two lateral halves of the furrow of the optic disc unite did not have strength enough to resist the pressure, which must have ensued in the course of years from the accommodative

efforts of the eye, and still more that, with the ensuing elongation of the eye in its horizontal axis, the bridge of communication must have been stretched backward, thus causing the deep excavation now seen with the ophthalmoscope. The three atrophic patches in the choroid, as well as the great distance of the choroidal ring from the margin of the papilla, show that traction must have been at work in the posterior segment of the globe.

It might appear doubtful whether, from the defect discovered in the upper-inner quadrant, we should be authorized to assume that the lower portions of the retina were defectively provided with nerve fibres congenitally, or that there was an atrophy of secondary origin.

The case reminds us exceedingly of the picture in Jäger's Atlas (Tafel xix, No. 87) of coloboma of the choroid and optic nerve, where precisely the same excavation of the lower part of the optic disc is represented as in our picture, and in the same way called coloboma of the optic disc. Liebreich,* in a communication on coloboma of the papilla just observed ophthalmoscopically by him, makes similar mention of the microscopic condition of the disc of the optic nerve of two globes with coloboma of the iris and choroid. He says: "The sheath of the optic nerve beneath the papilla before passing over into the sclera, was enlarged to a deep pocket, spanned over by a membrane continued from the optic nerve, while the edge passed over uninterruptedly into the scleral border, which was united only above, to the optic nerve, and so formed a circle of double the diameter of the optic nerve. The sinus itself was by no means regular, but had two deeper sub-divisions, etc., etc." Finally, for the sake of illustration, I will mention what v. Ammon found in the fœtal eye of a sheep's embryo.† He found the opticus hollow for quite a distance along its union with the sclera, and covered only by a thin membrane, which he believed to be the retina.

In comparing our four pictures with one another, I am

* Arch für Ophthal., Bd. v, 2, pag. 249.

† V. Ammon: zur Entwickelungsgesch. des Auges. Gräfe's Archiv., Bd. iv, 1, pag. 108–215.

inclined to see in them a certain succession, since from our knowledge of the normal processes in the development of the optic nerve, they can be looked upon as arrests of development at various stages. Indeed the pedicle of the ocular vesicle (the optic nerve) is furrowed at a certain period of embryonal life at its lower part, close to the sclera, to serve here as a conducting structure for the parablastic elements—the bearers of the intra-papillary vascular trunks—just as other elements enter the interior of the ocular vesicle through the fissure in the secondary ocular vesicle. This furrow is now gradually closed downward by thickening of its edges and walls, whereby on the one hand the trunks of the central vessels lie nearer to the centre of the conducting structures, and on the other the form of the pedicle must take a rounded shape. In the fœtal eye, as well as in the newly born, the line of union of the closed furrow shows itself as a raphe, to which a slight indentation on the lower side of the pedicle corresponds as we see, when we cut off the optic nerve close to its scleral insertion.

Figure 4 stands now nearest to this fœtal state, where the development and form of the papilla are quite normal, and the sheathing of the vessels regular, since both upward and downward coursing vessels originate from the centre of the optic nerve disc. The raphe alone, that is to say, the structure forming it, is not normally developed. No firm union has here taken place, but a pocket-like sinus just originated, and later developed itself into a deep excavation, perhaps by increase in intra-ocular pressure, perhaps as a result of efforts at accommodation.

If the closure of the furrow was arrested before a ring-like union was effected, the optic nerve must have naturally become a horizontal ellipse, with a more or less linear border at its base. The central vessels, therefore, could only be partially situated in their normal position in the optic nerve, since there was lack of material wherewith to sheath them. The optic disc therefore must exhibit a surface drawn backward and downward.

We see these details exactly in Fig. 1, the right eye of

our first patient. The papilla is a horizontal oval, double the normal size; the upper central vessels only originate nearer the centre, while the lower at the floor of the original furrow arise from the bottom of the surface of the excavated disc.

We find Figs. 1 and 3 in the most backward stages of development, and in about equal degree. The disc is about three times as large as normal, the lower border is represented by a line curved a trifle downward, the surfaces recede far backward, the vessels could never become imbedded; both venous and arterial trunks rise almost wholly from the floor of the excavation up to the retina.

The observation resulting from our cases, that the closure of the fissure of the choroid and that of the optic nerve are both entirely independent of each other, is interesting and entirely in correspondence with our knowledge of the normal process of development. Defective development can ensue in the one without fissure of the optic nerve disc, as is proved by the numerous cases of choroidal and iridochoroidal coloboma on record, and conversely a disturbance of development in the optic nerve may take place while the secondary ocular vesicle has closed completely.

REPORT ON THE PROGRESS OF OPHTHALMOLOGY FOR THE SECOND HALF OF THE YEAR 1878.

(Continued from Volume viii, p. 428.)

By Dr. A. NIEDEN, of Bochum.

Translated by Dr. R. O. Born, of New York.

IV.—Special Pathology.

CONJUNCTIVA.

401. Monoyer reports the cure of a case of membranous purul. conj. with pur. infiltration of the cornea. (*Gaz. d. Hôp.*, No. 69.)

402. Mühlenbach. On the etiology and prophylaxis of phlyctænular inflammation of the eye. (*Inaug.-Dissert., Greifswald.*) 14.5 per cent. of all the eye patients belong to this category.

403. Reymond. On contagious conjunctivitis in the schools of Turin. (*A. d' Ott.*, 1878, vol. iv, pag. 587.)

404. J. Roosa. On Conjunctivitis. (*The Medical Record*, vol. xiv, No. 1, New York, July 6th.)

405. Berlin, E. found that the emptying of the mucous follicles of the conjunctiva in trachoma diminishes the inflammatory symptoms. (*Z. M.*, xvi, Aug., pag. 352.)

406. Herpain and Blumberg. On granulations under the conjunctiva and on trachoma from the standpoint of cellular pathology. (*Journ. de Brux.*, vol. lxvi, pag. 579, and vol. lxvii, pag. 21 and 121.)

407. Iwanoff thinks that the long duration of trachoma and its tendency to relapses is caused by the acinous glands which he could always demonstrate. (cf., No. 252.) The inoculated blennorrhœa is specifically destructive to these new-formations. (*C. f. A.*, 1878, supplement, pag. 3, and *Z. M.*, vol. xvi, suppl., pag. 14.)

408. REICH found among 370 Armenian school children trachoma in boys 30 per cent., in girls 20 per cent., the percentage of affections of conjunctiva in boys 60 per cent., in girls 73 per cent. (*C. f. A.*, Oct., 1878, pag. 228.)

409. SCHELL. On granular ophthalmia. (*Phil. Med. Surg. Reporter*, vol. xxxix, pag. 55, July 3d.)

410. BAUMGARTEN. A case of tubercular ulcers of the conjunctiva of the lid. (*A. f. O.*, vol. xxiv, 3, pag. 225, ff.)

411. JODKO NARKIWICZ. Amyloid degeneration of the conjunctiva of the lid. (*Gaz. Lekarska*, 1878, July.)

412. GRATIA. On chancre of the eye. (*Press. Méd.*, vol. xxx, pag. 33 and 36.)

413. BULL, CH. STEDMAN. Syphilis of the Conjunctiva. (*Amer. Journ. of. Med. Sciences*, Octob., 1878.)

414. LEVI, LIVORNO. Lipoma of the conjunctiva caused by a foreign body. (*Bollet. di Occol.*, 1878, No. 4.)

415. RAFFA. On lupus of the conjunctiva.

CORNEA.

416. GALEZOWSKY. On febrile herpes of the cornea. (*R. d' O.*, Octob., 1878, pag. 288.)

417. GALEZOWSKY. La dégénérescence calcaire de la cornée. It is a consequence of phosphaturia leading generally to blindness. (*Gaz. Méd.*, pag. 37.)

418. GALEZOWSKY. Interstitial syphilitic keratitis is rare in lues. Syphilis of the brain can cause rodent ulcer of the cornea. (*R. d' O.*, Oct., 1878, pag. 302.)

IRIS, CILIARY BODY AND CHOROID.

419. JONSECA, L. Casos clinicos. Hernia consid. e astiga da iris. (*Per. de Ophth. prat.*, 4. Julto.)

420. BENTON. Idiopathic mydriasis cured with eserine. (*Br. Med. Journ.*, July 13, 1878, and *A. Sandford Morton*, l. c. July 27th, pag. 141.)

421. RAINSFORD. Congenital irideremia of both eyes. (*Br. Med. Journ.*, Sept. 7th, pag. 359.)

422. STORY. Acquired irideremia, traumatic coredialysis. (*Br. Med. Journ*, Sept., pag. 359.)

423. ANGELUCCI. Tuberculosis of the eyeball, starting from Fontana's lymph-spaces in a girl 15 years of age without further symptoms of tuberculosis. (*Z. M.*, Dez., 1878, pag. 521.)

424. KNAPP. A case of spongy irido-choroiditis, affecting both eyes at an interval of seven months. (*A. O. O.*, vol. vii, pag. 49.)

425. LEBER found in diabetes mellitus the aqueous humor to contain a small percentage of sugar and very considerable quantities of albumen. (*C. f. A.*, August, supplement, pag. 11, and *Bericht der Heidelb. Vers.*, vol. xi, pag. 39.)

426. MEYER, E. On the affections of the uveal tract in their relations to the sexual life of women. (*Gaz. des Hôp.*, 1878, pag. 108.)

427. AUGER stated in a syphilitic girl, 17 years old, primary tuberculosis of the choroid. (*Société de Chirurg. de Paris*, Nov. 27, 1878.)

428. ADAMÜCK. A case of rupture of the choroid in the centre of the yellow spot, presenting a round white patch with indented margins, in consequence of a blow. It could be observed that the rupture became gradually smaller and that the vascularization began from the margins until the rupture became entirely closed again, only a few pretty large clusters of pigment in the centre of the defect indicating the former condition. (*C. f. A.*, Nov., 1878, pag. 257.)

429. HÜLSE, E. Remarks on ruptures of the choroid. (*Inaug.-Dissert.*, 1878, Kiel.)

430. REICH observed in a man who was struck by lightning, a recent rhomboidal rupture of the choroid between equator and ora serata. S.=½. F. limited inwards and down and outwards. (*Z. M.*, August, 1878.)

431. AYRES, Cincinnati. Five cases of sympathetic ophthalmia. (*A. O. O.*, vol. v, pag. 221.)

432. BRESGEN. Cases of vasomoter neurosis. (*B. Fränkel's D. Z. f. pract. Med.*, 1878, No. 48, 30 Nov.)

433. BRESGEN. Two cases of sympathetic ophthalmia. (*Wiener Med. W.*, No. 45.)

434. V. D. LAAN. Cura da ophthalm. sympathica. (*Per. d. ophth. pract.*, 4 Julto.)

435. ROOSA. On sympathetic ophthalmia. (*Med. Record*, July 20, 1878, vol. xiv, 3.)

436. TAUBNER. Two cases of sympathetic ophthalmia after ossification of the choroid. (*Inaug.-Dissert., Greifswald*, 1878.)

GLAUCOMA.

437. CHIBRET, Dr. Contribution à l'étude du glaucome. After iridectomy for glaucoma he observed the long known occurrence of astigmatism. (*Arch. génér.*, 1878, Oct., pag. 503, and *A. d'O.*, 80, pag. 128–137.)

438. EMMERT. On glaucoma. (*Correspondenzbl. f. schweiz. Aerzte*, 1 Nov., 1878.)

439. FUCHS. On glaucoma. He maintains the connection between choroiditis and glaucoma, which he found in three-quarters of all the cases observed. (*C.F.A.*, August supplement, pag. xv, continued Dez., pag. 293 and Ber. der xi. *Heidelberg. Vers.*, pag. 65, ff.)

440. HOCK. The present state of the doctrine of glaucoma. (*Wiener Klinik*, vol. iv, 6, 1878.)

441. HOCK. On the theories of glaucoma. (*Wien. Med. Rundschau*, 1878.)

RETINA AND OPTIC NERVE.

442. ANGELUCCI. Thrombosis of the central retinal vein. First case: insufficiency and stenosis of the mitral and insufficiency of the aortic valves; affection on the left side. Second case: insufficiency of the mitral valve in acute articular rheumatism. Characteristic: 1. Affection on left side; 2. Total and sudden amaurosis; 3. Result of periphlebitis; and 4. Absence of extensive retinal hæmorrhages in both young patients. (*Z. M.*, Oct., 1878, pag. 443, and Bericht der xi. *Heidelb. Vers.*, pag. 182, cf., *C. f. A.*, August, supplement, pag. xviii, with illustrations.)

443. PFLUEGER observed hæmorrhagic retinitis in pernicious anæmia in the form of radiating extravasations following the course of the vessels, and resembling blood-vessels. (*C. f. A.*, August, supplement, pag. 47, and Bericht der 11. *Heidelb. Vers.* pag. 175.)

444. MACKENZIE, STEPHAN. On idiopathic, essential or progrogressive pernicious anæmia. (*Lancet*, 1878, 7 Dec.)

445. LEUBE. On the diagnosis of spontaneous septicopyæmia, he considers the clinical importance of the retinal hæmorrhages. (*D. Arch. f. kl. Medic.*, vol. xxii, pag. 237–278.)

446. KRAMZSTYK. Contributions to the knowledge of retinitis leucæmica. (*Pannictniek. Tow. Sek. Warsa*, 1878, pag. 576.)

447. MICHEL. On thrombosis of the central vein in leucocy-

thæmia and fatty heart. (*C. f. A.*, August, supplement, pag. xvii, and Bericht der 11. *Heidelb. Vers.*, p. 181.)

448. OELLER. Contributions to the pathological anatomy of the eye in leucocythæmia. Description of an eye of a man 31 years old, who died of splenic leucocythæmia. Very accurate measurements of the thickness of the different membranes. (*A. f. O.*, vol. xxiv, 3, pag. 239.)

449. KOSLOWSKY observed albuminuric retinitis in intermittent fever. (*Kaukas. Med. Gesellsch.*, No. 14, 1878.)

450. LITTEN. On the pathology of the kidneys. In amyloid degeneration of the kidneys, without albumen in the urine, he found neuroretinitis and a picture of the retina corresponding entirely to that in albuminuric retinitis. (*Berl. Klin. Wochenschr.*, No. 30, 1878.)

451. MACNAMARA. On albuminuric retinitis in pregnancy. (*Lancet*, 1878, 14 Dec.)

452. WILBRAND, H., of Breslau. Neuritis axialis occurs suddenly, with S. n. mostly in both eyes of young people. Central scotoma is the first symptom, central vision is considerably reduced, the ophthalmoscopic picture entirely negative, and toxic amblyopia excluded. The scotoma is a vertical oval. We must distinguish an idiopathic and a symptomatic form. The latter, observed at the beginning of cerebral diseases, takes a much more rapid course and early termination. (*Z. M.*, Dec., 1878, pag. 505, ff.)

453. BURNETT, SWAN M., of Washington. Double optic neuritis (choked disc) and sloughing of the right cornea, accompanying a sarcomatous tumor on the right side of the brain. (*A. O. O.*, vol. vi, pag. 469.)

454. v. HIPPEL observed atrophy of the lateral portion of the left tract and of the medial portion of the right tract, seven years after the enucleation of the left globe. (*C. f. A.*, August, supplement, pag. 17. and Ber. der 11. *Heidelb. Vers.*, pag. 180.)

455. LAWSON. Blessure du nerf optique sans lésion du globe ocul. (*Gaz. Méd.*, 41, pag. 507.)

456. CRAS. Cécité unilatérale p. contusion rétrooculaire. (*Soc. de Chirurg. de Paris*, 27 Août, 1878.)

457. NUËL. In amblyopia alcoholica, resp. central scotoma, where red and green appear gray, yellow and blue are perceived correctly. A patient with delirium tremens had S.=$\frac{1}{15}$, but a

central scotoma for red. (*Bull. de l' Acad. de Méd. de Belg.*, Août, 1878, and *A. d' O.*, vol. 80, pag. 105–118.)

458. ATKINSON observed optic neuritis after lead-poisoning. He proved the presence of lead in the brain. (*Lancet*, July, 1878, pag. 22.)

459. LEDIARD. A painter who suffered from lead-colic and old symptoms of lead-poisoning was slightly delirious and amaurotic for three days. (*Med. Times*, Aug. 24, 1878, pag. 217.)

460. GALEZOWSKY. On megrim of the eye and periodic hemianopsia; it affects chiefly the female sex, occurs frequently under the picture of hemianopsia or of central scotoma in one or both eyes, is transitory, passes sometimes over into complete transitory amaurosis, and is often accompanied with cerebral symptoms. Slight asthenopia after the attack is over. (*Gaz. Hebd.*, No. 2, 1878.)

461. COURSSERANT. Amblyopia with hemianæsthesia in hysteria. (*Gaz. des Hôp.*, 1878, pag. 42.)

461. LANDESBERG, Philadelphia. On the pathology of the sympathetic nerve; treats also of the symptoms of transitory amaurosis. (*A. O. O.*, vol. vii, pag. 408.)

463. PAGENSTECHER, H. found in a family hemeralopia hereditary for many decades, affecting only the male members of the family after passing one generation over. (*C. f. A.*, August supplement, pag. xl, and Ber. der 11. *Heidelb. Vers.*, pag. 149.)

464. PÖTSCHKE. Contributions to the diagnosis and prognosis of amblyopia by measuring the visual field. (Berlin, July 9, 1878), from *Dr. Hirschberg's* clinic.

465. HERTER uses the ophthalmoscope for the detection of the simulation of one-sided amaurosis and amblyopia, throwing the light or illuminated letters alternately into the one or the other eye by indirect ways. Persons with normal vision or simulating persons, are unable always to refer correctly the impression of light, or if he is able to recognize the letters with the amblyopic eye, the simulation is detected. (*Z. M.*, Sept., 1878, pag. 385, and *Deutsche Militärärztl. Zeitschrift*, 1878, pag. 9 and 10.)

466. KÜHNE treats of the same subject. (*Tagebl. der Naturf. Vers.*, Cassel, No. 6, pag. 167.)

VITREOUS BODY.

467. SCHMIDT-RIMPLER affirms the genuine inflammation of the elements of the vitreous body upon experiments with blennor-

rhoic secretion from the lachrymal sac. (*C. f. A.*, August, supplement, pag. 26, and Bericht der 11. *Heidelb. Ver.*, pag. 100.)

LENS.

468. BAUDON found congenital cataract in thirteen patients of the same family in four generations. (*Rec. d' O.*, 1878.)

469. GUAITA. Subconjunctival luxation of the lens with subsequent sympathetic cyclitis. (*A. d' Ott.*, vol. vii, pag. 385.)

470. LEBER observed the regeneration of defects of the anterior lens capsule by proliferation of the capsular epithelium. (*C. f. A.*, August, supplement, p. 10, and cf. *Bibl.*, No. 263.)

471. OELLER. On the etiology of posterior polar cataract. *Inaug.-Dissert.*, Munich, 1878.)

472. RODET. Étude sur les ruptures de la zone de Zinn et la subluxation traumatique du cristallin. (*Thèse*, Paris, 1878.)

473. TAMAUSCHEFF. De l'extraction et de la résorption de la cataracte. (*Gaz. des Hôp.*, 1878, No. 3, pag. 21.)

474. LANDESBERG, Philadelphia. On 123 cataract operations. *A. f. O.*, vol. xxiv, 3, pag 59.)

475. KNAPP observed after peripheral division of the capsule much less irido-capsulitis and irido-cyclitis during the healing process of cataract extractions. (*C. f. A.*, August, supplement, pag. 46, and Bericht der 11. *Heidelb. Vers.*, pag. 170, ff.)

476. RYDEL. Observations on cataract and cataract operations from October, 1869, until December, 1877, Krakau. The opinion that cataract occurs more frequently in persons working in salt-works, as in Wieliczka, on account of the hygroscopicity of chloride of sodium, is refuted, there being only 7.65 per cent. of the whole number; 361 cataract operations, 5.5 per cent. failures. (*Przegland Lekarsky*, No. 15–20.)

477. SCHMIDT reports 212 cataract operations from Völker's clinic at Kiel. Loss 3.77 per cent., good results 93.39 per cent. (*Inaug.-Dissert.*, Kiel, 1878.)

ACCOMMODATION AND REFRACTION.

478. ALFERMANN demonstrated an ophthalmoscope for the examination without a dark room. (*Naturforsch.-Vers. zur Cassel, Tageblatt*, pag. 72, and *C. f. A.*, Oct., 1878, pag. 253.)

479. ENGELHARDT, G. A new form of ophthalmoscope. A stable apparatus; the eye which is to be examined, receives light from an uncovered planoparallel glass plate placed immediately in

front of the eye; the fundus is observed through a system of lenses which are put in between the observer and patient. (Munich, 1878, 36 pages, 1 plate.)

480. GILLET DE GRANDMOT. Refraction ophthalmoscope. (*A. d' O.*, vol. 80, pag. 90.)

481. HIRSCHBERG. On the objective determination of refraction, (*C. f. A.*, 1878, pag. 26, cf. *Bibl.*, 302,) speaks of the advantage of examining the erect image over Schmidt-Rimpler's method.

482. PFLÜGER. Phakometer and chiastometer. For sale at Hern and Fister at Berne. (*C. f. A.*, August, supplement, pag. xii, and Bericht der 11. *Heidelb. Vers.*, pag. 46.)

483. SAMELSOHN, Cologne. On increase and decrease of refraction by reflex action in conjunctivitis. (*C. f. A.*, August, supplement, pag. xiii, and Bericht der 11. *Heidelb. Vers.*, pag. 53.)

484. PESCHEL. On the astigmatism of indirect vision. (*Unters. des Physiol. Laborat. zu Zurich*, 1878.)

485. CHARCOT AND GALEZOWSKY. Visual disturbances in hysterical patients, and hysterical spasms of accommodation and subsequent myopia. (*Progr. Méd.*, 1878, No. 3.)

486. TITECA, M. Pathogénie et prophylaxie de la myopie. (Bruxelles, 1878, 8°, 135 pages.) Prismatic glasses are recommended.

487. OTT observed in Lucerne 132 eyes during four years, and found that 33 per cent. had remained stationary, and 67 per cent. showed a higher degree of refraction. Of 38 H., 12 had remained the same, 5 had passed over into lower degrees, 18 into E., and 3 into M.; of 68 E. eyes, 34 had remained the same, 34 had become M.; of the 26 M. eyes, 25 showed a higher degree of M. (*Corresp. Blatt f. Schweiz. Aerzte*, August 1, 1878.)

488. REICH found in the schools of Tiflis, (1,258 pupils) more myopic Armenians and Georgians than Russians. 100 per cent. resp. 90 per cent. to 70 per cent. (Remarks on the eyes of the Armenians and Georgians in the schools of Tiflis. *A. f. O.*, vol. xxiv, 3, pag. 231.)

489. v. REUSS confirms that in myopic eyes the radius of curvature of the anterior surface of the lens is generally much greater than in E. The focus of the lens is accordingly greater than in E. The thickness of the lens is in M., almost without exception, less than in E., the principal focal distances are in M. generally greater. (*A. f. O.*, vol. xxiii, 4, pag. 183.)

OCULAR MUSCLES.

490. FRIEDREICH. On ataxia of the movements of the eyeball in hereditary ataxia. The author thinks it is caused by disturbance of the constant synergy of the external ocular muscles. (*C. f. A.*, August supplement, pag. xxii, and Bericht der 11. *Heidelb. Vers.*, pag. 198.)

491. PFLÜGER observed nystagmus in affections of the ear. (*Deutsche Zeitschr. f. Pract. Med.*, 1878, No. 35.)

492. NIEDEN. Forty cases of nystagmus in miners. It is only observed in cutters; the rotating form is prevalent. It is supposed to be caused by a debility of the nerves, especially of those of the ocular muscles, similar to the tremor of old people, and the result of similar lesions. It is always accessible to treatment. (*Fränkel's D. Z. f. Pract. Med.*, 1878, No. 46.)

493. RÄHLMANN. On nystagmus, entertains similar views on the nature of nystagmus; in regard to its etiology he accents its neuropathic character: 1. Since it is frequently found with malformations of the head and eyes; 2. Since with nystagmus there is frequently shaking of the head or blepharospasm; 3. Since we observe it, though later, in central troubles, lesions of the brain, disseminate sclerosis, ataxia. It is influenced by binocular vision, acuteness of sight and by illumination. (Nystagmus of miners, *A. f. O.*, vol. xxiv, 4, pag. 237–317.)

494. ROMIÉE DE LIÈGE found among 1,000 miners, when leaving the mine 238 cases of nystagmus, among 100 in the evening before entering only 7 cases; he thinks it caused by fatigue of the muscles of accommodation, which gradually leads to clonic contractions of the external muscles. (*Le Scalpel, Liège*, 7 July, and *A. d'O.*, vol. lxxx.)

495. RONNÉE. Recherches sur le nystagmus. (Paris, Delahaye, 1878.) 77 pages; describes a nystagmometer.

496. WARLOMONT. On nystagmus, especially in miners. (*Presse Méd.*, vol xxx, pag. 31.)

497. ULRICH. On the etiology of convergent squint, lays stress upon the fact that squint is not caused by H., but by the relation of H. to convergence. If in H. a certain degree of accommodation can only be effected by a corresponding degree of convergence, squint will result with the same necessity as for normal muscles and accommodation, the convergence corresponds exactly to the accommodation. H. persons, therefore, with equal

S. on both sides who do not find out the advantage of disuniting their accommodation and refraction, renounce to the advantage of distinct vision derived from squinting. (*Z. M.*, October, 1878, pag. 421.)

498. DEHENNE, A. A rare form of squint. (*Gaz. des Hôp.*, 57.)

499. GRAUX. On paralysis of the abducens, with conjugate deviation of the eyes in a patient suffering from bulbar paralysis. The author assumes a connection between the root of the sixth cranial nerve and the third nerve of the opposite side by a vertical bundle. (*Soc. de Biolog., de Paris* 23 Nov., 1878, and *Gaz. Méd.*, 1878, No. 50.)

LIDS.

500. BROWN-SÉQUARD. On ptosis as an effect of brain disease. (*Lancet*, ii, 1878, pag. 17–18.)

501. MEYERHAUSEN. Total closure of the lids by complete destruction of the conjunctiva after measles. Cornea opaque and slightly ectatic. Operation unsuccessful. (*Z. M.*, August, 1878, pag. 364.)

502. JODKO NARKIEWIZ. Syphilitic tubercles on the eyelids of a 25 year old patient. (*Gaz. Lekaska*, 1878.)

503. TALKO. A foreign body remaining in the eyelid for a long time. Mydriasis persisted after its removal. *Milit. Med. Journ.*, Sept, 1878.)

504. ALT. On Xanthelasma tuberos. palpebr. (*A. O.* vol. viii, pag. 113.)

505. JONSECA, L. Polypo da palp. infer. Excisao. (*Per. de ophth. pratic.*, 4 Julto.)

LACHRYMAL APPARATUS.

506. BERLIN, R., reports two cases of one-sided lympho-sarcoma of the lachrymal gland, which were removed; he places their origin in the inter-acinous connective tissue. (*C. f. A.*, August supplement, pag. 2, and Bericht der 11. *Heidelb. Vers*, pag. 2.)

507. FANO thinks that tumor and fistula sacci lacrymalis is produced by ostitis of the inner canthus, and proposes direct treatment of the bone affection. (*J. d'O.*, July, 1878, and *Arch. génér. d. M.*, Oct., and *Gaz. Méd. de Paris*, pag. 31.)

508. SABADINI. Contrib. à l'étude pathol. et au traitement des tumeurs et des fist. du sac lacrym. (Paris, 8°, 36 pages.)

ORBIT.

509. BERLIN observed in a horse double-sided inflammatory exophthalmus (meningitis, infarctions in lungs and spleen) as consequence of thrombosis of the external jugular vein, resp. of the sinus, after blood letting. (*C. f. A.*, August supplement, and Bericht der 11. *Heidelb. Vers.*, pag. 167.)

510. BULL, CHAS. S. On the pathology of inflammation of the orbital cellular tissue. (*Amer. Journ.*, July, No. cli, pag. 112.)

511. DUPLAY. A case of fracture of the orbit. Exophthalmus; amaurosis by a gun-shot into the temple. (*Arch. génér. de Méd.*, Dec,, 1878.)

512. SCHIESS, BASEL. Five cases of inflammation of the retrobulbar cellular tissue. (*Z. M.*, July, 1878, pag. 305.)

513. DE SMET. Inflammation of the cellular and fatty tissues of the orbit, terminating in absorption. (*Presse. Méd.*, vol. xxx, pag. 78.)

514. CREDE. Exostosis of the frontal, nasal and superior maxillary bones, exophthalmus, choked disc, œdema of the retina, operated with preservation of the globe. (*D. Z. f. pract. Med.*, 1878, No. 35, pag. 414, and *cf. Gesellsch. f. Nat. u. Heilkunde*, Dresden, 3 Nov., 1877.)

515. VIEUSSE. On the connection between the arachnoidal space and Tenon's capsule. (*R. d'O.*, Oct., 1878, pag. 314.)

516. THERMES. Goître exophth. à forme grave guéri par hydrothérapie pour 1½ ans. (*France Méd.*, No. 81 and 83.)

517. SÉE, GERMAIN. Sympt. de la maladie de Basedow. (*France Méd.*, No. 87, ff.)

518. SCHALKHÄUSER. Aneurism of the internal carotid, with pulsating exophthalmus. (*Inaug.-Dissert.. München, Z. M.*, 1878, 2, supplement, *cf. C. f. A.*, 1878, pag. 81.) Literary references inexact.

519. GOSETTI. Angioma simpl. orb. dextr. Extirpation. (*A. d'O.*, 1878, pag. 265.)

OCULAR TUMORS.

520. BAUMGARTEN. A case of tubercles of the conjunctiva, cornea and iris, with remarks on tuberculosis of the eyeball and tuberculosis in general. Ophthalm.-histological communications. (*A. f. O.*, vol. xxiv, 3, 163. resp., 213.) Reviewed and criticised by WALB. (*Z. M.*, Dec., 1878, pag. 530.)

521. BLODGETT, Boston. Case of primary carcinoma of the conjunctiva. (*A. f. O.*, vol. xxiv, 3, pag. 257.)

522. BERGER. Gumma of the conjunctiva bulbi. (*Bayer. ärztl. Int. Blatt.*, 1878, vol. xxv, pag. 17.)

523. RAVÁ, A. Steatoma. (Cystic tumor of the region of the brow. Extirpation and death.) (*A. d'O.*, 1878, 2 and 3, pag. 248.)

524. SCHIESS, BASEL. Dermoid of the caruncle. (*Z. M.*, Nov., 1878, pag. 484.)

525. ANGELUCCI. 1. Melanotic choroidal sarcoma; 2. A melanoma, which in ten years had become extraocular, and which had led to sympathetic inflammation of the other eye. (*Z. M.*, September, 1878, pag. 397, ff.)

526. ALT. A case of choroidal sarcoma, with formation of cartilage. (*A. O. O.*, vol. vi, pag. 304.)

527. HOLMES, Chicago. 13 cases of ocular tumors, a tumor of the optic nerve, and a case of panophthalmitis with a coagulum having the appearance of a tumor. (*A. O. O.*, vol. vi, p. 291.)

528. WALTON, HAYNES. Glioma of the retina. (*Lancet*, 1878, 30 Nov., pag. 767.)

529. WIGHERKIEWICZ. A case of glioma retinæ. (*Pryzeglad Lekarsky*, 1878, No. 34 and 35.)

530. FRÄNKEL introduced a needle through sclerotic and vitreous body, to make the differential diagnosis between detachment of the retina and subretinal tumor. The enucleation revealed retinal glioma. (*C. f. A.*, Dec., 1878, pag. 286.)

531. BUROW observed an osteoma of the orbit, which exfoliated spontaneously. (*Berl. klin. Wochenschr.*, 1878, 21 October.)

532. KRAUSE. Two cases of foreign body in the eye. (*Inaug.-Dissert. Greifswald*, 1878.)

V. LITERATURE.

533. ADAMÜCK. Ophthalm. observations from the clinic of the university of Kasan, vol. ii, 2, pag. 243.

534. ADLER. Report on the treatment of eye patients in the K. K. Krankenhaus Wieden. Vienna, 1878, 24 pages. He speaks of the visual purpre in enucleated eyes.

535. ALT. Clinical report of 3873 eye patients, treated at the N. Y. Ophthalmic and Aural Institute. (*A. O. O.*, vol. vi, 304 345.)

536. Baltimore Presbyterian eye and ear charity hospital. First annual report, 1878.

537. v. Bezold's report of the private Institute for eye and ear patients at Munich. (*Aerztl. Intell.-Blatt.*, 1878, No. 44.)

538. Castorani. Rendiconto statistico della R. Clinica ophthalmica di Napoli., 1878.)

539. Danesi, Girolamo. Eye clinic of Dr. Andr. Simi. 1878. (*Lo Sperimentale*, vol. xlii, pag. 269.)

540. Dor. Second annual report of the eye clinic at Lyons, 1878.

541. de Haas. 13. Verslag der Augenklinik zu Rotterdam, 1878.

542. Haltenhoff. Premier rapport de la clinique à Genêve, 1878.

543. v. Hasner. Annual report of the ophth. department, from the medical report of the general hospital at Prague ; for the year 1877 (1878.)

544. Hosch and Landolt's eye clinic. (*Correspdzbl. f. schweizer Aerzte.*, 1878, No. 22, 15 Nov.) The instruments used in the clinic are described. The chromastometer is new.

545. Janv, Breslau. Annual report for the year 1878.

546. Massachusetts char. Eye and Ear Infirmary, 53d annual report, Boston, 1878.

547. St. Michael, Newark. Annual report of the ophthalmic hospital, New York, 1878.

548. Peschel. Report of 942 patients. (*B. Fränkel's D. Z. f. p. M.*, 1878, No. 47 and 48.)

549. Oeller. Report of Prof. Rothmund's ophth. clinic at Munich. (*Ann. des städt., Krankenhauses*, 1878, Munich.)

550. Saltini. Univ. di Modena. La clinica oculist. del 1875–1877. (*A. d'O.*, vol. vii, pag. 286.)

551. Schöler, Berlin. Annual report for 1878 of the ophthalmic institution of the late Dr. Ewers. Peters, Berlin.

552. Wichekiewicz. First report of the Ophthalmic Institute at Posen.

553. De Wecker et Landolt. Traité complet d'ophthalm. Anat. microscop. par les Proff. Arnold, Iwanoff, Schwalbe et Waldeyer, vol. i, 1, pag. 146, fig. et 2 pl. 672 pag., Paris, Delahaye, 3 parts. Translation of the corresponding chapters in *Graefe-Saemisch's cyclopædia.*

554. De Wecker. Thérap. oculaire., vol. ii, Paris, 1878. Continued from vol. i. (*cf.*, No. 224 of this bibliogr.)

555. Perrin. Maur. Atlas des malad. prof. de l'œil, compr. l'ophthalmosc., ii. édit. augm. de 2 pl. et l'anat. pathol. par F. Poncet, 92 pl. en chromolith. Paris. Masson.

556. Zehender. Lehrbuch der Augenheilkunde. Stuttgart, Enke, 1879.

557. Nagel's annual report on the progress of ophthalmology during the year 1876. Vol. vii, Tübingen, Laupp, 1878, 571 pages, with 816 numbers, resp. 587 authors.

558. Dudgeon. The human eye; its opt. construction, pop. explained. London. Hardwicke and Bogue, 1878, 92 pages, 31 illustrations.

559. Angell, Henry, of Boston. The sight, and how to preserve it. London. Hardwicke and Bogue, 1878.

560. Hart, C. The diseases of the eye. Detroit, 1878, 336 pages.

561. Hart, C. The diseases of the brain and the eye. 1878, 428 pages.

562. Lander. On the relations between the eye and the brain during waking and sleeping, and its changes by disease. (*Arch. f. Psych.*, vol. ix, pag, 1.)

563. Künstle. Ophthalmological notes from the period of A. v. Haller. Munich. Ackermann, 1878, 8°, 23 pages.

564. Cohn, H. The school-hygiene at the Paris exhibition, 1878. Breslau. Morgenstern.

565. Dor. Étude sur L'hygiene oculaire au lycée de Lyon. Paris. Masson, 1878. Similar results concerning the occurrence of M. as in Germany.

566. Liebreich. The influence of school-life upon sight and short-sightedness. London. Churchill, 1878.

567. Colsman. Test-types for the determination of M. in schools. Barmen. Wiemann, 7 pag., with illustr., 8°.

568. Tentscher. Contribution to the statistics of eye patients and eye operations. (*Inaug-Dissert.*, Berlin, 1878.)

569. Behrend. The diseases of the skin, for physicians and students. Wreden, Brunswick, 1878, pag. 569, 128 wood-cuts, treats also especially of the skin diseases of the lids.

570. Adelmann. On endemic eye diseases among the Estes in Livonia, and among related tribes in the Russian empire. (*Tagebl. d.* 51. *Naturf.-Vers.*, Cassel, No. 4, pag. 96.)

571. Ocanna, Lopez y Santa Cruz. On inflammation of the conjunctiva. Madrid, 1878, 60 pages.

572. Dutrieux. Consid. général. sur l'ophthalmie d'Egypte. Le Caire, 1878. Impr. de l'Etat maj. génér., 148 pages. Long historical introduction. The author does not recognize a specif. egypt. eye disease, but regards it as a transition from catarrh to blennorrhœa and trachoma.

573. Krebs. On the healing of perforating scleral wounds with and without conjunctival flaps, after experiments on the rabbit. (*Inaug.-Dissert.*, Berlin, 1878.)

574. Bernauer. De l'hypopion et de son traitement. Paris, 8°, 40 pages.

575. Landesberg. Contribution to the statistics of diseases of the lens. (*Z. M.*, vol. xvi, 1878, 3. supplement.)

576. Del Monte. Settanta estrazioni di cataratta dura col pro. clin. modific. dal 1876, al princ del 1878. (*A. di Ott.*, vol. vii, pag. 197.)

577. Anagnostakis. Encore deux mots sur l'extraction de la cataracte chez les anc. Athènes, 1878. The author is in opposition to the views of v. Graefe, Hirsch and Magnus.

578. Schmidt. Contribution to the statistics of the modified linear extraction. (*Inaug.-Dissert.*, Kiel, 1878.)

579. Larionow, Tiflis. Disease of the eye in typhus. (*Z. M.*, Nov., 1878.)

580. Mengen. Eye affections after diseases of the teeth. (*Rec. d'O.*, October, 1878, pag. 324.)

581. Baron. Étude clinique sur les troubles de la vue chez les hystériques. (*Thèse*, Paris, 1878, *cf. Poncet., Progr. médic.* 1878, No. 48.)

582. Lebris. Les différ. formes cliniques des atroph. papill. (*Thése de Paris*, 1878, 8°, 40 pages.)

583. Tizon. Étude clinique de l'atrophie on phthisie de l'œil. (Paris, 8°, 76 pages.)

584. Pacton, Marc. Du zona ophthalmique. (Paris, 1878, 8°, 114 pages.)

585. Crespi. On the injuries of the eyeball and its annexa, observed in the eye clinic at Milan. (*A. d'Ott.*, 1878, vol. iv, pag. 535.)

586. Reich. The lesions of the eyeball in gun-shot wounds of the head. (*Milit Med. Journ.*, Sept. and Oct., 1878.)

587. Yrert. Du traumatisme du globe de l'œil. (*R. d'O.*, October, 1878, pag. 337.)

MODIFICATION OF THE ARTIFICIAL LEECH.

By FRANCIS B. LORING, M. D., Washington D. C.,

Instructor of Ophthalmology and Otology in National Medical College, Surgeon-in-Charge Washington Eye and Ear Infirmary, one of the Consulting Ophthalmic and Aural Surgeons to the Princeton Hospital, etc., etc.

THE principal faults in the cutting apparatus of the leech introduced by Baron Heurteloup, are due to the facts that the "drill," being worked by a *lateral* motion, is apt to produce a rough and uneven incision, often leading to a subsequent scar, and that after a short period of use the set-screw, regulating the extent of the knife exposed (and the consequent depth of the incision), is apt to become so worn that it is no longer safe to apply the motion directly with the fingers—discarding the string entirely, as I have been accustomed to, in cases where I was particularly anxious to avoid permanent scars. So frequently, however, has this occurred, even with the greatest care, that I have for the last few years adopted the plan of first having a natural leech applied and then putting the cylinder directly over the recent bite. This, however, is not always convenient, and is sometimes objected to by the patient, so that I venture to hope that the instrument now described will prove useful, particularly in those places where leeches are not always attainable. The first change necessary was to reduce the lateral motion of the string or cord to a vertical one, and this was accomplished by fixing the drill in a cylinder, the motion to which was given by two lateral pistons, joined at their extremities to a disk of the same diameter as the enclosing cylinder. A perforation was then made

* Read before Med. Society, Dist. Columbia, Oct., 1879.

through the centre of the disk, in which was ground a female screw, and through this the drill, armed with a spiral screw, was led, so that the revolution was made in very much the same manner as the instrument now shown in the shops, by simply moving the piston, as in the common syringe. The amount of knife exposed is regulated, not by a set-screw, but by a sheath that screws over the cutting-edge of the drill, and is an inch in length, so that it cannot yield to any force of pressure that can be applied to it. This sheath is the same as that in the other instrument, with the exception that instead of being bevelled at the extremity it is perfectly even, and is armed with a circle of thick plate-glass. This glass is of the same diameter as that of the exhausting cylinder, and serves two purposes: First, in the original Heurteloup the extremity is of brass, and naturally obscures most of the tissues from the eye of the operator, while they are now directly in sight, even to the edge of the drill; in the second place, on removing the instrument from the temple, the incision is found to be *directly in the centre* of a ring formed by the pressure of the glass against the skin, so that the air-tight exhausting cylinder has to be placed against the outer circle, which it exactly fits, to ensure a rapid and speedy flow of blood. For any one that has been in the habit of using the instrument, must have been troubled by the difficulty of having a deep incision strangulated by the drawing in and compression of the tissues, particularly when in a flabby and relaxed condition, and this difficulty I have always found to be increased when the incision was not directly in the centre, from the pressure of the wound against the walls of the glass cylinder. As the end of the piston with its washers fills the mouth of the receiver when it is first applied to the temple, it is often most difficult to place it directly over the centre of the incision, and the circle from the pressure of the glass is therefore a most valuable and reliable guide. By a very simple mechanism the glass disk may be unscrewed, and various sizes corresponding to different cylinders easily fitted. I have now had the instrument in use for some little time, both in private practice and in the hospi-

tals, and I find that patients complain but very slightly of the pain of its application, and that in no case has a scar resulted. This is due, doubtless, to the fact that the incision produced is clear and even, there being no lateral traction with a plowing up of the tissues on one side, and that the cut being directly in the centre, the blood flowed from the entire circle, so that one part of it was not more elevated than the other by the force of the vacuum. I am in the habit of allowing the blood to follow the washer very closely, and to regulate its flow by the depth of the incision, and not by increased suction. The wound is dressed with vaseline or simple cerate, and a piece of plaster applied some few hours *after* the removal of the cylinder.

The instrument weighs but three ounces, and is contained in a case measuring six inches by three; it cannot easily get out of order, and is but slightly more expensive than the original design. It can be obtained from Shepard & Dudley, 150 William Street, New York. Price of the Leech $9.00; price of the Leech with cylinders in case $15.00.

AN ABSTRACT OF AMERICAN OPHTHALMOLOGICAL LITERATURE.

FROM JULY 1ST, 1878, TO JULY 1ST, 1879.

By Dr. SWAN M. BURNETT, of Washington, D. C.

1. Chronic granular conjunctivitis. By T. E. Murrel. Richmond and Louisv. *Med. Journ.*, July, 1878.

2. The ophthalmoscope as a diagnostic means in various forms of disease. By J. A. White. Richmond and Louisv. *Med. Journ.*, Dec., 1878.

3. The subject of pterygium in its relation to transplanting the cornea. By J. J. Chisholm. Richmond and Louisv. *Med. Journ.*, Oct., 1878.

C. proposes to make use of an artificial pterygium in the operation of transplantation of the cornea, and in the following manner:

The conjunctiva is loosened from its attachment at the edge of the cornea, and advanced, by means of the "puckering" action of a circular suture, to occupy about two-thirds of the corneal surface. The conjunctiva will form an attachment to the cornea, and the whole will be vascularized as in the pathological condition of pterygium. The eye of the animal is subjected to the same process. When the process of vascularization is completed, the conjunctiva of the eye of the patient is dissected up to the edge of the limbus, and a part of the center of the opaque cornea removed. The same thing is done to the eye of the animal, except that the whole of the cornea with the overlying conjunctiva is removed, and the cornea cut away from the perephrey to the point where the advanced conjunctiva joins the clear cornea. This is now fitted into the hole made in the human eye, and the edges of the two portions of the conjunctiva brought together and the eye bandaged. No cases are given.

4. Foreign body in ant. chamber successfully removed. By S. C. AYRES. Cincinnati *Lancet and Clinic*, 1878, p. 285.

The foreign body (a splinter of wood) was removed by making a transverse incision through the cornea, and introducing a blunt Tyrrell's hook, which was rotated about the foreign body and drawn out. This brought the splinter between the lips of the incision, from which it was extracted by a pair of fine serrated forceps.

5. Myotics and glaucoma. By W. W. SEELY, Cincinnati *Lancet and Clinic*, 1878, p. 249.

Dr. S. holds that, in some way, not perhaps yet clearly understood, myotics are of service in the various forms and stages of glaucoma.

6. Causes of failure in operations for stricture of the nasal duct. By W. W. SEELY. Cincinnati *Lancet and Clinic*, 1878, p. 208.

Dr. S. does not express a preference for any one of the various modes of operation, but thinks that the success is often marred by a mal-position of the punctum, faulty slitting of the canaliculus and closure of the opening into the sac, to which three points he calls the attention of operators.

7. The use of mercury in eye diseases. By J. J. CHISHOLM. *Maryland Med. Journ*, Nov., 1878.

Dr. C. advocates the use of mercury in all eye affections in which the 5th pair of nerves is implicated, as iritis, blepharitis and corneal affections.

8. Intra-ocular circulation ; rhythmical changes in the venous pulse of the optic disk. By O. F. WADSWORTH and J. J. PUTNAM. *Journ. of Mental and Nervous Diseases*, Oct., 1878.

Compression of the jugular veins caused no perceptible alterations in the intra-ocular circulation.

Pressure on the carotid caused a cessation of the physiological pulsation of the vena centralis. By inhalation of nitrite of amyl, the *first* result was a lessening of the cardiac pulsation ; the *second* result was a persistent distention of the vein to a point attained during the hight of a long wave (mentioned below), the cardiac pulsations continuing. There was observed in addition to these cardiac pulsations a larger pulsation, occurring in periods corresponding to about five respirations.

9. Remarks based on a case of total blindness (with sudden recovery of sight) following brain lesion. By A. D. Rockwell. *Virginia Med. Monthly*, Sept., 1878.

Sudden and total blindness came on after a severe epileptiform attack. Two months after a strong induction current was applied to both eyes for two minutes with immediate restoration of vision. R. thinks recovery would have taken place spontaneously, but the reflex stimulation of the electricity hastened the process.

10. Gonorrhœal ophthalmia. By J. G. BROOKS. *Virginia Med. Monthly*, Sept., 1878.

11. The use of yellow oxide of mercury in eye diseases. By GEO. REULING. *Virginia Med. Monthly*, Nov., 1878.

12. Cases in the eye service of Dr. J. Chisholm. By E. A. CHANCELLOR. *Virginia Med. Monthly*, Nov., 1878.

1. Symblepharon, with successful operation by transplanting the conjunctival flap from one part of the eyeball to another.

2. Excessive ciliary stophyloma, in which the eyeball attained the diameter of one inch and a half, with excessive displacement of the recti muscles. Removal of the ball.

3. Ciliary stophyloma from a perforating injury of the cornea.

4. Alopecia palpebrarum.

5. A briar transfixing obliquely the substance of the cornea.

6. A recurrent tumor (size of a pigeon's egg) lying beneath and parallel with the lower lid of the left eye. Removed by injections of acetic acid.

13. Ischæmia of the retinæ, by T. R. POOLEY. *Ohio Med. and Surg. Journ.*, August, 1878. Relates two cases of ischæmia retinæ and total blindness in anemic conditions, one caused by malarial fever, the other by miscarriage. Recovery in both after removal of producing causes.

14. Observations on the treatment of blepharospasm, by H. G. CORNWALL, *Ohio Med. and Surg. Journ.*, Dec., 1878. The treatment consists in forcible dilatation of the sphincter palpebrarum.

15. Glaucoma, iridectomy, melanoma, sympathetic irritation, enucleation, by J. H. CURRAY. *Toledo Med. Journ.*, Nov., 1878,

16. *Ophthalmic fragments, by E. Smith. Michigan News, Sept.* 10, 1878.

1. *Extraction of foreign body from the vitreous, with preservation of the form and appearance of the eye,*

2. *Sympathetic neuro-retinitis following injury. Unique pathological condition of the wounded eye.*

The unique pathological condition was a dislocation of the lens

downward in front of the ciliary body between this and the sclera, the iris being pushed before it; no external rupture of the coats of the ball.

17. Cases of Cataract operated on by a modification of Gräfe's method, by Prof. FROTHINGHAM, *Mich. Med. News*, Oct. 10, 1878.

Simply a tabulated statement of thirty cases. Results from ⅔ to ⅛ in all cases, except 4. No complete loss.

18. Opium as a tonic and alterative with remarks upon the hypodermic use of sulph. morph. and its use in debility and amaurosis consequent upon onanism, by B. A. POPE. *N. O. Med. and Surg. Journ.*, March, 1879.

P. considers the sulph. morph. hypodermically used a new remedy in certain forms of amblyopia and amaurosis, as, for instance, in that following excessive hemorrhages and in diabetes metitus.

19. Contribution to injuries of the eye, by S. C. AYERS. *Am. Lancet and Clinic*, April 22, 1879.

1. Foreign body in crystaline lens 14 months; swelling of the lens and escape of the foreign body into the ant. cham.; iridectomy.

2. Foreign body in the orbit; threatened sympathetic inflammation; enucleation.

3. Incised wound of the eye-ball; enucleation.

20. Extraction of cataract within the lenticular capsule, by GEO. REULING. *N. Y. Med. Journ.*, January, 1879.

After giving a history of the operation and the advantages and dangers attending it, R. proceeds to give his plan for the removal of the lens in the capsule. He makes a large incision in the limbus corneæ, larger than in the Gräfe operation; also a broad iridectomy. Pressue is to be made by means of the fixation forceps at the lower corneal margin, and simultaneously at the upper margin of the incision. If the lens does not then present itself, a spoon (Daviel's) is introduced behind the lens and the lens is then lifted out.

21. A criticism of Dr. De Rosset's theory of the action of the muscles of accommodation, by D. HUNT. *N. Y. Med. Journ.*, January, 1879.

H. combats Dr. De R.'s idea that accommodation is passive for near, and active for distant vision.

22. The use of Eserine and Pilocarpine in ophthalmic therapeutics, by C. S. BULL. *N. Y. Med. Journ.*, April, 1879.

In some cases of phlyctenular ophthalmia the blepharospasm and photophobia were improved by eserine, a less number were benefited by atropine. In ulcus serpens eserine gave good results as also in the corneal ulceration attendant on gonorrhœal conjunctivit. No especial advantage in dacryo-cystitis, keratit. parenchym., oph. symp., staph. corneæ and episcleritis. No especial advantage from the local application of pilocarpine, but it was employed with advantage hypodermically in opacities of the vitreous and chronic scrofulous sclero-keratitis.

23. In corneal affections, a mydriatic or myotic, which? by W. W. SEELY. *Cinc. Lancet and Clinic*, Feb. 1, 1879.

S. answers as follows:

"For cerneal troubles the myotic, eserine or preferably muriate of pilocarpine. For complicating iridal affections the substitution of Duboisia for atropia."

24. A case of marked susceptibility to Duboisine, by W. W. SEELY. *Cin. Lancet and Clinic*, Feb. 15, 1879.

After the instillation of 4 drops of a 4 gr. solution of Duboisine "strange" feelings, vertigo, sleepliness and a dryness of the throat came on.

25. Keratoscopy, by JULIA W. CARPENTER, *Cin. Lancet and Clinic*, March 1, 1879.

26. Observations in relation to some forms of affection of the eye resulting from reflex irritation, by P. D. KEYSER. *Med. and Surg. Rep.*, March 8, 1879.

K. Gives in this address an account of eye troubles which are met with as the result of reflex irritation from decayed teeth, the uterus, rectum and kidneys.

27. A case of sympathetic ophthalmia with remarks on the exciting cause of the disease, by D. B. D. BEAVER. *Med. and Surg. Rep.*, March 15, 1879.

28. Remarks on Duboisia, by W. W. SEELY. *Cin. Lancet and Clinic*, Jan. 11, 1879.

29. Optico-ciliary neurotomy, by Dr. WADSWORTH. *Bost. Med. and Sur. Jour.*, March 20, 1879.

W. performed this operation in the usual manner, after dividing the ex. rect. muscle, in a case of dreaded symp. oph. The operation was successful. The cornea is insensible, and no pathological process has set in. On the 12th day a small clot of blood was found in the ant. chamb., but in a few days it was absorbed.

30. Color-blindness, by B. J. JEFFRIES. *Bost. Med. and Sur. Jour.*, March 27, 1879.

A preliminary report on the examination he was then carrying on.

31. Two cases of glaucoma, with some remarks on the relative frequency of the disease in America and Europe, by HASKET DERBY. *Bost. Med. and Sur. Jour.*, March 20, 1879.

D. finds on an examination of the statistics, that glaucoma is more frequent in Europe than in America, the European per cent. being 1.24; the American 0.66.

In one of his reported cases, pain persisted while the ant. chamb. was still open, and disappeared on healing of the wound; an argument, he thinks, against the "filtration" theory of glaucoma. The second case illustrates the unexpected amount of good an iridectomy may accomplish even in a case of chronic glaucoma that had been treated by atropine.

32. Atropia, duboisia, eserine, pilocarpine and muscarine, by E. L. HOLMES. *Chicago Med. Jour. and Exam.*, April. 1879.

No personal observations are recorded.

33. A case of general miliary tuberculosis involving the choroid, by E. L. HOLMES. *Chicago Med. Journ. and Exam.*, March, 1879.

34. On some of the unusual effects of atropine and the means to counteract them, by F. C. HOLTZ, *Chicago Med. Journ. and Exam.* Jan. 1879.

In a case of very marked idiosyncracy against atropia, H. succeeded in entirely avoiding the symptoms by a combination of morph. sulph. with the atropia solution.

35. Ophthalmological casuistry. By O. R. LAUNG. *N. O. Med. and Surg. Jour.*, May, 1879.

1. Corpus alienum bulbi oculi. 2. Ulcus serpens corneæ.

36. Color-blindness in its relation to accidents by rail and sea. By F. HOLMGREN. Translated by M. Duncan. (Reprint from report of the Smithsonian Institution for 1877.)

37. Report of fifteen interesting cases of eye disease. By A. BLITZ. Trans. Tenn. Med. Soc., 1878.

38. A manual of examination of the eyes. By E. LANDOLT. Translated from the French by S. M. Burnett, No. 307. Phila., D. G. Brenton.

39. Successful transplantation of a rabbit's conjunctiva to the

human eye for the cure of symblepharon. By A. W. CALHOUN. *Southern Prac.*, January, 1879.

40. Weak eyes (asthenopia), By W. CHEATHAM. *South. Prac.*, February, 1879.

41. Remarks on Glaucoma. By A. BLITZ. *South. Prac.*, March, 1879.

42. Treatment of ophthalmia neonatorum. By E. SMITH. *Mich. Med. News*, March 10, 1879.

43. Practical hints on the treatment of corneal affections. By E. SMITH. *Ibid.*, April 25.

S. has found eserine useful in cases of corneal abscess.

44. Some forms of iritis and their consequences. R. GEBSER. *St. Louis Courier of Med.*, April, 1879.

45. Sympathetic ophthalmia. By B. E. FRYER. *St. Louis Courier of Med.*, June, 1879.

46. Trichiasis and Distichiasis; reflections upon their nature and pathology; with a radical method of treatment. By C. E. MICHEL. *St. Louis Courier of Med.*, February, 1879.

Those interested in the controversy on this paper between the author and Dr. J. Green will find the papers in the March, April and May numbers of the *Courier*.

47. Is glaucoma ever of sympathetic origin? By DAVID WEBSTER. *Archives of Med.*, April, 1879.

W. answers this question in the affirmative, and gives the histories of two cases in support of his view.

48. Sulphate of eserine in acute glaucoma. By T. R. POOLEY. *Archives of Med.*, June, 1879.

While eserine cannot be relied upon to cure glaucoma, Pooley thinks it will in a large number of cases of the acute form give a temporary benefit, which will allow the patient to be prepared for an operation. Four cases are given.

49. A rare accident. By J. W. CRANSHAW. *Med. Herald*, June, 1879.

A piece of briar $\frac{1}{16}$in. long embedded in cornea, its free end in ant. chamber. Removed with a pair of iridectomy forceps through the opening made by its entrance at the outer margin of the pupil.

50. Spectacles, and how to avoid their use for a time. By W. CHEATHAM. *Louisville Med. News*, June 14, 1879.

He stimulates the ciliary muscle by a solution of eserine, gr j, ad $\frac{3}{3}$ i aq., dropped in at bed-time.

51. 1. Rupture of eyeball from glaucoma. 2. Rupture of choroid with hemorrhage into vitreous from a blow. By W. CHEATHAM. *Louisville Med. News* January 21, 1879.

52. Spectacles in youth. By R. H. LEWIS. *N. C. Med. J.*, August, 1870.

53. Excision of the eye. By T. J. MOORE. *N. C. Med. J.*, July, 1879.

54. Ophthalmia neonatorum .By R. H. LEWIS. *N. C. Med. J.*, March, 1879.

55. Ophthalmia neonatorum. By J. H. LETCHER. *Med. Herald*, May, 1879.

56. Ectropion of lower lids. By M. F. COOMES. *Med. Herald*, May, 1879.

57. The Phakometer. S. D. REYNOLDS. *Med. Herald*, May, 1879.

58. Mydriasis. By W. DICKINSON. *Ill. Med. Recorder*, Jan., 1879.

59. The treatment of inflammation of the conjunctiva by means of medicated spray. By DAVID WEBSTER. *Phys. and Pharm.*, April, 1879.

The spray is applied by means of a Delano's atomiser to the conjunctiva alone when the cornea is unaffected, but to the cornea also in cases of panenus. W. has found this efficacious when the usual applications had failed. He uses commonly: Tan. acid, gr. x; glyc., ʒij; ag., ʒj; but other solutions can of course be employed.

60. Sympathetic neuro-retinitis, with remarks on sympathetic ophthalmia. By G. C. HARLAN. *Am. J. Med. Sci.*, April, 1879.

H. reports three cases where the sympathetic ophthalmia took the form of neuro-retinitis. In his discussion of the operative treatment of symp. oph., he holds to the principles of most universal acceptance in regard to enucleation,—that is, removal of a lost and irritable eye, especially if it contains a foreign body, even though no symptoms of symp. irritation are present, in those cases where the patient cannot be closely watched. In those, however, who can be kept under surveillance, wait until some threatening symptoms are developed.

61. Enucleation of an eye for sympathetic irritation. By LEARTUS CONNER. *Detroit Lancet*, January, 1879.

Gun cap in the eye 15 years previously. Eye shrunken; wore an artificial eye; sympathetic irritation in other; enucleation.

An examination of the enucleated stump disclosed a bony transformation of the choroid.

62. Filaria in the eye. By C. S. TURNBULL. *Med. and Surg. Rep.*, October 26, 1878. T. reports one case of filaria in the eye of a horse which came under his own observation, and reports two others from other observers. He judges the parasites to be *Filaria papillosa Rudolphi.* It is also found in the human eye. Cases are cited.

63. Duboisia as a mydriatic. By W. F. NORRIS. *Amer. J. Med. Sci.*, April, 1879.

N. had used duboisia in thirty cases, and the results of his experience were that the action of this mydriatic was more rapid than that of atropine, both as regards the pupil and accommodation; its effects, on the other hand, pass off more rapidly. The true effects on animals experimented on by him were intoxication, delirium, dilatation of the pupils, loss of coördinating power over the limbs, relaxation of the sphincters, marked rise succeeded by a decided fall of temperature. The true effects on man are of about the same character,—dryness of the throat is not complained of so much as in atropia poisoning. Its action in breaking up synechia is not so powerful as that of atrophia. He has substituted it with good effect in some cases where atropia had produced conjunctivitis.

64. Sympathetic ophthalmia. By E. DYER. Trans. Med. Soc. of Penn., 1878.

65. Simple conjunctivitis. By Dr. MICHEL. Trans. Med. Ass. of Missouri, 1878.

M. deprecates the use of astringents in the simple form of conjunct. The disease he considers self-limited. Hygiene measures should alone be employed.

66. Retinal red and its relation to the sensation of sight. By H. S. SCHELL. (Review) *Amer. J. Med. Sci.*, July, 1878.

A critical review of all the papers that had appeared up to date on the subject of the retinal red.

67. A contribution to the pathology of orbital cellulitis. By S. C. BULL. *Amer. Journ. Med. Sci.*, July, 1878.

B., after considering the general clinical features of orbital cellulitis, gives the histories in detail of five cases, all ending in destruction of the eye. The first case originated in an aggravated exacerbation of trachoma and pannus; the second from a lacerated wound of the eyelids; the third from an ulcus serpens cor-

nel; the fourth was spontaneous, referable to exposure to cold; the fifth followed an iridectomy for glaucoma. In three of the cases suppuration did not occur.

68. Recent contributions to the study of glaucoma. By S. M. BURNETT. (Review) *Amer. Journ. Med. Sci.*, April, 1879. A critical review of some of the recent more important papers on the subject.

69. Encysted tumors of the eyelids and vicinity. By C. S. BULL. *Amer. Journ. Med. Sci.*, April, 1879.

B., after giving a detailed consideration of our existing knowledge of the various forms of cysts occurring in the vicinity of the eyelids, hordeola chalazia, dermoid, sebaceous, etc., gives six cases that had fallen under his personal notice: 1. A cyst in the left upper lid, following a blow on the eye. It was found to have no distinct cell wall, but was formed from a dilatation of the connective tissue between the orbicularis and tarsus. It healed when its cavity was injected with a strong tinct. of iodine. 2. A large sebaceous cyst in the lower lid of a strumous girl of two years. 3. An encysted sebaceous tumor of the right upper lid, in the submuscular connective tissue, in a healthy child of five months. 4. Sebaceous cyst of the lid, which had undergone partial suppuration in a man of 45. 5. Encysted tumor (dermoid) of right upper lid and eyebrow, in a man of 23. Congenital. 6. Prelachrymal fluid cyst, in a woman of 55. Appeared three years previously, at the inner angle of the right eye. When seen was the size of a hazel nut. There was no inflammation, but a flow of tears, from obstruction of sac due to pressure. It was dissected out, and found to contain an oily fluid.

70. Color blindness: its dangers and detection. By B. JOY JEFFRIES. Boston, 1879. Houghton, Osgood & Co. 329 pp., 1 pl., 8°. An excellent treatise, containing, besides a good deal of original work, a compilation of the many investigations which have of late been made on the subject.

71. Atrophy of the optic nerve. By F. B. LORING. *Nat. Med. Rev.*, Feb., 1879.

L. relates the case of a man of 32, a drinker and smoker, who was affected with atrophy of the o. n., with restriction of V. F. and S=$\frac{2}{10}$, who by the use of the artificial leech, hyperdermic injection of strych. and abandonment of drinking and smoking, was brought up to a usual power of $\frac{2}{20}$.

72. The new mydriatic. By F. B. LORING. *Nat. Med. Rev.*, May, 1879.

An account of duboisia, with the results of its trial in sixteen cases of iritis. L. considers it as good or superior to atropia in breaking up adhesions.

73. Color-blindness. By S. M. BURNET. *Nat. Med. Rev.*, April, 1879.

An account of the recent theories and investigations on the subject, with a summary of the writer's examinations in colored school children.

74. Retinal irritation. By S. D. RISLY. *Phil. Med. Times*, August 17, 1878.

Among the causes, R. cites undue sexual indulgence and refractive errors.

75. The relations of ametropia to some forms of inflammatory lesions of the eye and lids. By W. M. MASTIN. *Rich. and Louisville Med. Jour.*, June, 1879.

M. gives a number of cases where he considered inflammatory eye troubles were due to errors in refraction.

76. Eye troubles in general practice. By H. D. NOYES. *N. Y. Med. Jour.*, April 19, 1879.

A clear account of the eye troubles that are usually met in general practice, with the best method of treating them.

77. Filaria in the eye of a horse. By C. J. KIPP. *N. Y. Med. Rec.*, February 1, 1879.

K. made an incision 4 *mm.* in length in outer half of the cornea, when the aqueous and the parasite came out. The worm was 65 *mm.* long, and 0.3 *mm.* in diameter.

78. Note on the oleate of mercury in eye diseases. By M. LANDESBERG. *Phil. Med. Times*, July 20, 1878.

The oleate is considered by L. to be superior to the yellow oxide in the treatment of eye troubles.

79. Traumatic aneurism of the eyelid following an operation for trichiasis. By F. C. HOTZ. *N. Y. Med. Rec.*, June 14, 1879.

In splitting the lid in the operation a small arteriole was wounded, which subsequently underwent aneurismal enlargement and burst, causing considerable hemorrhage. The sac was excised with curved scissors, and the trouble relieved.

80. Cataract extraction, with a statement of 250 cases. Dr. C. R. Agnew. *N. Y. Med. Rec.*, May 10, 1879.

In most of the cases the method of Gräfe was adhered to. He usually gave ether to profound anesthesia. The peripheral capsulotomy was thought to be a valuable addition to our operative

procedures. Preliminary iridectomy was valuable in exceptional cases only.

Of those extracted by Gräfe's method, 146 were successes, 20 partial, 15 failed, 3 unknown. In the Liebreich process, 21 were successful, 2 partial, 6 failures. In Gräfe's method, with preliminary iridectomy, 22 successes, 2 partial. In Lebrun's method, 4 successes, 2 partial, 1 failure. By the flap method, 6 successes.

81. A peculiar form of corneal opacity. By R. H. DERBY. *N. Y. Med. Rec.*, May 3, 1879.

An account with a wood-cut of the band-shaped corneal opacity in a man 54 years of age, with a diagram showing the limitation in the V. T. upward, inward and downward.

82. On the therapeutic use of jaborandi and pilocarpine in eye diseases. By M. LANDESBERG. *Phil. Med. Times*, April 26, May 10, 1879.

L. gave the ext. jaboran. by the stomach in 8 cases, and the result of his experience is that they favor the resorption of intra-ocular hemorrhages, opacities of the vitreous, and serous effusions better than any absorbent known. As a myotic he thinks eserine superior to pilocarpine.

83. Cases of foreign body in the orbit, having passed through the eyeball. By P. D. KEYSER. *Phil. Med. Times*, March 29, 1879.

Two cases: 1. A shot passed through the globe antero-posteriorly, and lodged in the tissue just to the outer side of the o. n. 2. A piece of iron, ¾ in. in length, passed through the sclera on the inner side of the cornea, and lodged in the tissues on the inner side of the nerve.

84. On the therapeutic use of calabar and eserine in eye diseases. By M. LANDESBERG. *Phila. Med. Times*, October 26, 1878.

L. has found eserine of decided value in the treatment of the following affections: deep diffuse or circumscribed ulcerations of the cornea; in keratocele; in maculæ corneæ; in perforating wounds of the cornea; in certain forms of torpid infiltration of the cornea; in paralysis of the musc. of accom., consequent upon diphtheria; in traumatic mydriasis; in glaucomatous processes.

85. Glaucoma. Its literature, nature, indications and remedy. By WM. DICKINSON. *Amer. Med. Bi-weekly*, March 1, 1879.

86. Amaurosis puerperalis transitoria. By C. WALLISER. *St. Louis Med. and Sur. Jour.*, January, 1879.

A primipara, æt. 18, had convulsions following a rather pro-

tracted labor. Sudden and complete blindness. Slight febrile excitement. Pupils dilated, fixed, insensible to light. No ophth. exam. Calomel five grs. every two hours until twenty grs. were taken and ice applied to the head. In forty-eight hours perception of light, and in two weeks was able to read newspaper.

87. The Ophthalmoscope in diseases of the nervous system. By W. F. NORRIS. *Med. News and Library*, March, 1879.

An interesting account of the present state of our knowledge of nervous diseases in which the oph. is a means of diagnosis.

88. On Conjunctivitis. By D. B. ST. J. ROOSA, *N. Y. Med. Rec.*, July 6, 1878.

89. On sympathetic ophthalmia. By D. B. ST. J. ROOSA, *N. Y. Med. Rec.*, July 20, 1878.

A case of atrophy of the optic nerve which was the result of a sympathetic trouble from its fellow which was wounded about thirty years before and had atrophied.

90. Cases of neurotic disturbances relieved by glasses. By H. N. READ. Proc. of Med. Soc., County of Kings, 1879, iv, p. 78.

91. Oyster-shuckers corneitis, (corneitis ostearii). By W. J. MCDOWELL. *Va. Med. Monthly*, January, 1879.

McD. describes a peculiar form of ulcer of the cornea met with in oyster-shuckers, which he attributes to a specific toxic element contained in the lime and dirt which coats the oyster shell. It is not due as might be readily supposed to traumatism.

92. Cause and prevention of squint. By H. S. SCHELL. *Amer. Journ. Med. Sci.*, October, 1878.

S. concludes that since str. conv. occurs in those cases of H. where the recti ext. as compared with the recti int. are weaker than the average, glasses to correct the total H. should be used as soon as the squint makes its appearance.

93. Daltonism or color-blindness. By G. C. H. HARLAN. (Review). *Amer. Journ. Med. Sci.*, October, 1878.

94. Action of the ciliary muscle in astigmatism. By H. GRADLE. *Amer. Journ. Med. Sci.*, January, 1879.

G. gives a case which seems to show that regular astigmatism may be partly or wholly corrected by an unequal contraction of the ciliary muscle.

95. A chip of brass in the ciliary body. Plastic cyclitis. By H. KNAPP. *N. Y. Med. Rec.*, June 21, 1879.

Two cases presented to the N. Y. Pathological Society.

96. The muscle of accommodation and its mode of action. By J. De Rossett. *Amer. Journ. Med. Sci.*, October, 1878.

After giving a detailed account of the anatomy and anatomical relations of the ciliary muscle, and the reasons why he thinks the commonly accepted theory of accommodation not correct, De R. states his opinion as follows: "I hold that the elastic power of the lens is in *opposing* relation to the contractile power of the ciliary muscle, the lens is thickened *ad maximum* for the nearest possible adjustment and centrariwise, when the muscle is in the state of greatest possible contraction, the elasticity is overcome and the adjustment is for the remotest point." In other words, accommodation for distance is active, for near, passive.

97. Syphilis of the conjunctiva. By C. S. Bull. *Amer. Journ. Med. Sci.*, October, 1878.

B. relates cases of primary sore, ulcerated mucous patches and gummy infiltration of the conjunct. which have fallen under his own observation, and cites other cases from various writers. The case of gumma of the conjunt. was associated with gummy infiltration of the sclera and a hemorrhagic diathesis.

98. Myxo-sarcoma of the orbit. By S. C. Bull. *N. Y. Med. Rec.*, March 15, 1879.

A boy of eight years slipped and wounded the skin over the malar prominence. Four days afterward he was admitted to the dispensary with swelling of the eyelids and the ball displaced upward and inward; conjunct. not injected. An incision was made under ether, but no pus was found; hemorrhage was slight. Next day a fungoid mass pushed the lips of the wound open, but there was no change in the eye; V., good; o. s. nil. Considerable hem. from the growth. Eye was enucleated and growth taken from the orbit, which was denuded to the periosteum. O. n. healthy-looking. Child did well. Mic. exam. showed the growth to be myxo-sarcomatous and very vascular.

99. Burns of the fovea centralis by concentrated solar heat. By A. D. Williams. *St. Louis Med. and S. J.*, May 19. (Trans. Med. Soc., p. 54.)

W. has observed a large number of cases, generally after eclipses of the sun, in which the patient's vision is affected in a more or less serious degree. Subjectively there is noticed a small central scotoma, while objectively, through the ophthalmoscope, a small, round, dark-colored spot is visible at the fovea centralis. He considers this condition due to a burning of that part of the

retina by a condensation of the sun's rays by means of the refractive apparatus of the eye.

100. Snake in the eye of a horse. By R. S. SWORDS. *N. Y. Med. Rec.*, February 15, 1879.

An account of a case published by John Morgan in Philadelphia in 1782.

101. On astigmatism as a cause for persistent headache and other nervous symptoms. By W. THOMPSON. *Med. News and Library*, June, 1879.

T. gives the histories of five cases of headache and other nervous troubles which were relieved by the correction of astigmatism.

102. Diagnosis of renal disease by the ophthalmoscope, with report of a case. By J. A. WHITE. *Va. Med. Monthly*, May, 1879.

103. Symblepharon complete, from idiopathic causes; a very rare case. By J. J. CHISHOLM. *N. Y. Med. J.*, January, 1879.

Patient had a cutaneous disease, called by his physician eczema, which, without doubt, affected the conjunctiva, causing a shedding of the epithelium and exposure of the raw surfaces. These raw surfaces of the palpebral and ocular conjunct. united with the *cul-de-sac*, and formed total symblepharon. One eye had been lost by operative interference. The remaining one was not interfered with. The cornea, from constant exposure, too, became dry, and was "steamy" and almost invisible.

104. Blindness caused by the use of tobacco, and how to prevent it. By J. J. CHISHOLM. *N. C. Med. Jour.*, December, 1878.

Dr. C. has seen 35 cases of tobacco amaurosis in 13,723 patients, a large per cent. for this country, which, however, he accounts for by the fact that his *clientèle* is drawn from that portion of the Southern States where smoking is more excessive than in other parts of the United States. He has never seen a case in a person under 30 years of age. He has met with it in women. Alcohol amaurosis unassociated with tobacco amaurosis he has never seen. The susceptibility varies with individuals. He has known persons to smoke as many as 30 cigars a day for years with impunity, whilst he has seen others affected by 2 or 3 a day. Amaurosis is not associated with chewers of the weed. His treatment is to leave off the habit, and give strychnia, which he thinks is just as effective when administered *per os* as hydodermically.

NOTE ON THE ADAPTATION OF THE OPERA GLASS TO EXTREMELY MYOPIC EYES.

By LEONARD WALDO, S.D., of Harvard University.

VERY probably some writer in elementary optics has examined this question. The desire to benefit a friend has led me to examine the matter however, and at the request of another friend who is an occulist, I have put the note in shape for publication.

For practical purposes we may consider a degree of near-sightedness to be represented by a convex lens of which the focal length in any case is equivalent to the distance from the anterior nodal point of the eye to the farthest point at which distinct vision occurs. Thus, for a person who has distinct vision at two inches from the nodal point referred to, the convex lens would be of two inches focus; we may obtain a sufficient approximation by measuring from the crystalline lens to the farthest point of distinct vision. The lens of this focus we shall call the equivalent lens of the eye.

This equivalent lens forms with the eye-lens of the opera glass a combination having a resultant focus which may be derived from the ordinary formula following, where F is the resultant focus of the combination. f_1 is the focal length of the equivalent lens of the eye. f_2 is the focal length of the eye-lens of the opera glass. a is the distance between the eye and the eye-lens.

$$\frac{1}{F} = \frac{f_1 + f_2 + a}{f_1 f_2}$$

and making $a = 0$, since the eye-lens is as near as possible to the eye, and remembering that f_2 is negative and numerically less than f_1, we have

$$\frac{1}{F} = \frac{f_1 - f_2}{-f_1 f_2}$$

which gives the resultant focal length of the combination of the eye-lens of the opera glass; for if f_1 is not numerically greater than f_2 then the resultant focus is positive, and vision with the opera glass becomes impossible.

Values of F for eyes having equivalent lenses of 2.2. 2.1, 2.0, 1.9, and 1.8 inches focus combined with eye-lenses of opera glasses having —1.3, —1.2, —1.1, —1.0, —0.9 and —0.8 inches focus are given in the following table, and it will be easy to compute from the same formula the value of F for any given eye in combination with any given eye-lens.

VALUES OF F.

f_2	f_1				
	2.20 *in.*	2.10 *in.*	2.00 *in.*	1.90 *in.*	1.80 *in.*
in.					
—1.30	—3.18	—3.41	—3.72	—4.12	—4.93
—1.20	2.65	2.80	3.00	3.26	3.61
—1.10	2.20	2.31	2.44	2.61	2.83
—1.00	1.83	1.91	2.00	2.11	2.25
—0.90	1.52	1.57	1.64	1.71	1.80
—0.80	—1.26	—1.29	—1.33	—1.38	—1.44

From the theory of the opera glass these values of F represent the distance to which the eye-piece must be moved from the focal point of the object glass toward the object glass itself. It is evident, therefore, that we must have a value of F which shall be numerically less than the value of the focal length of the object glass in order to have vision possible in any given case. It is desirable that the field of view be as large as possible, that the glass be compact, light and convenient in use, if it is to be the constant companion, and that it have an extreme range of vision with a magnifying power something less than two diameters. These conditions must be satisfied without bringing prominently into notice the aberrations of the lenses; fortunately, owing to the very low magnifying powers, we can use curves which for any great increase of telescopic power would be useless. I have seen from the house of R. & J. Beck, glasses which could be used by persons having distinct vision at three inches, and doubtless any reputable optician would furnish them. For a greater degree of nearsightedness, however, it is better to have them made with reference to avoiding undue curvature in the surfaces of the eye-lens, and capable of considerable extension between the eye-lens and object glass. Thus for a myopic eye of two inches equivalent focus the following details may be serviceable:

Achromatic object glass 4.5 *in.* focus, 1.5 *in.* aperature.

Achromatic eye-piece —1.10 " " 0.3 " "

Diaphragm 0.2 inches aperature, as near the eye piece as possible, and next the eye.

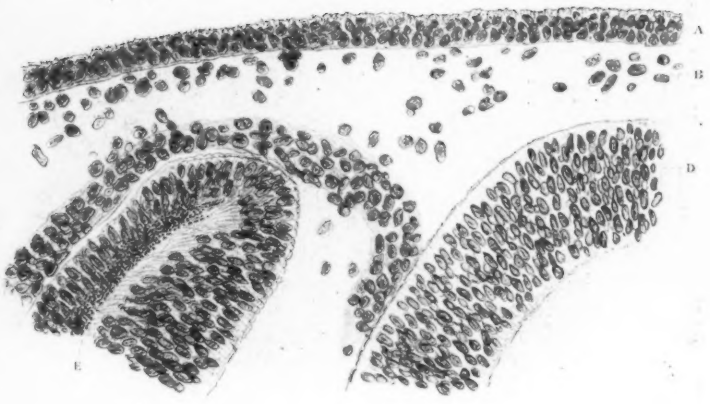
Nearest approach of the eye-lens to the object glass, measured between the inner surfaces to be 1.70 inches.

Greatest distance apart to be 2.70 inches.

Frames of Aluminium.

Such a lens would be adapted to vision at a few feet distant, and would seem to be satisfactory in every respect; of course, each eye can be fitted separately if they differ from each other.

Fig. 1.



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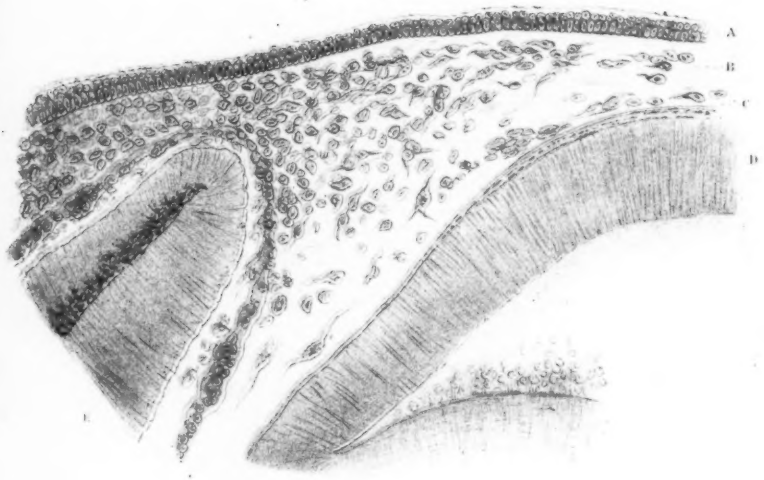

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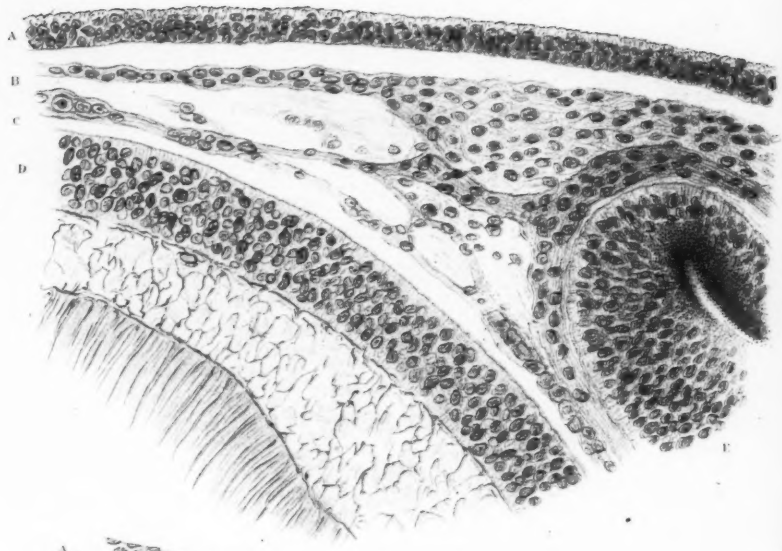

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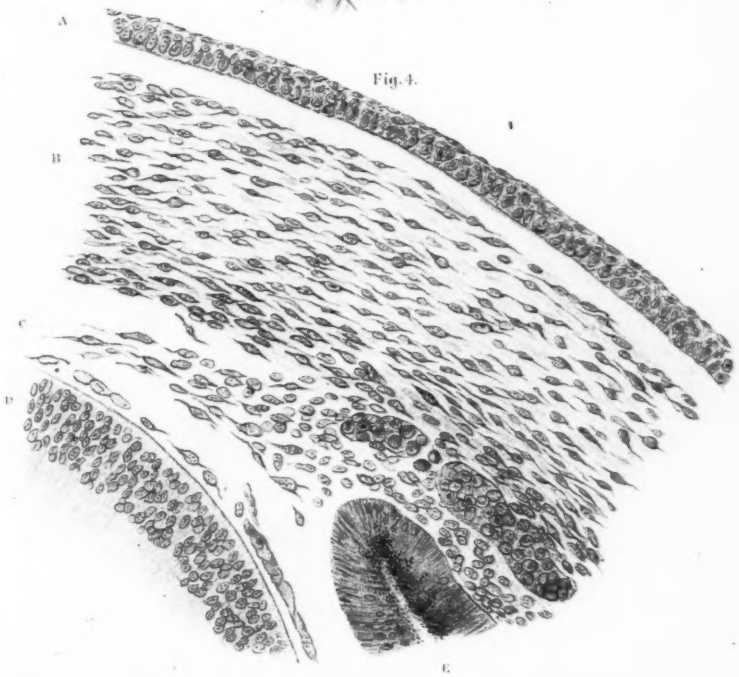
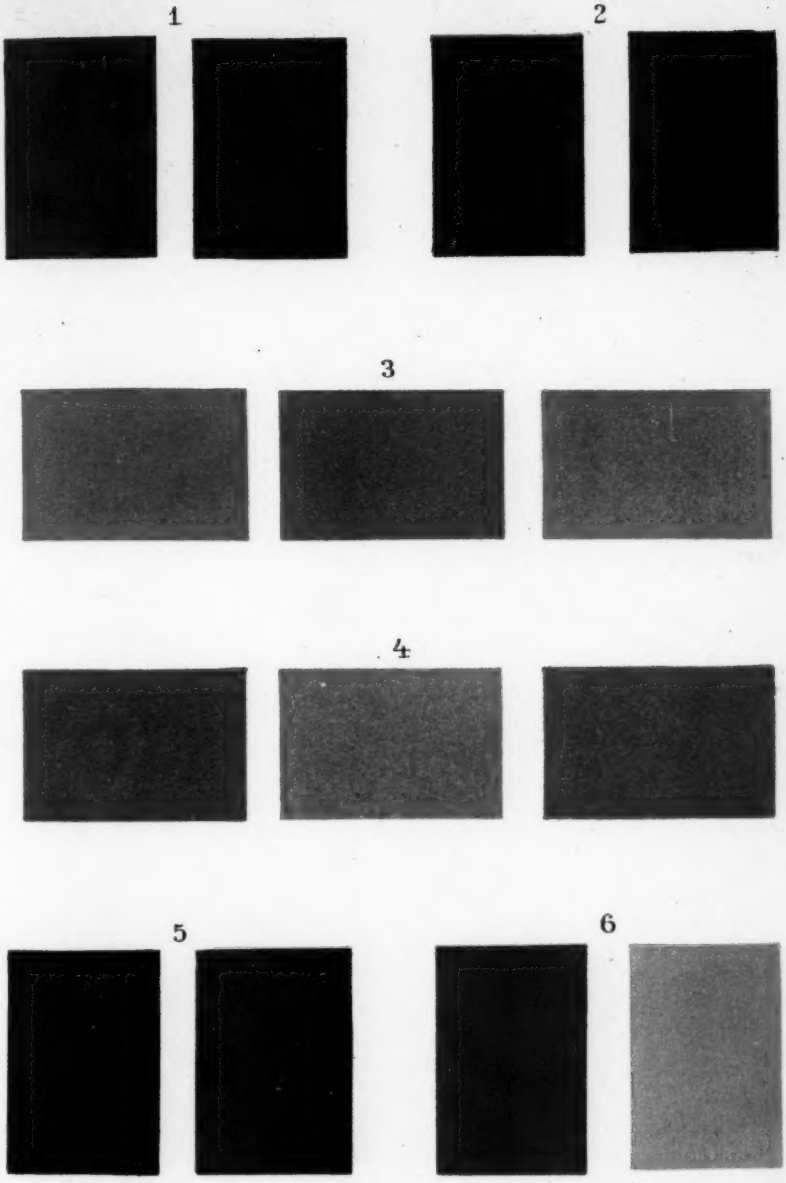
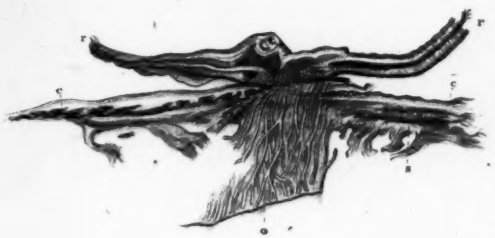




Artist. Anst. v. Th. Fischer. Cassel

Fig. 1.



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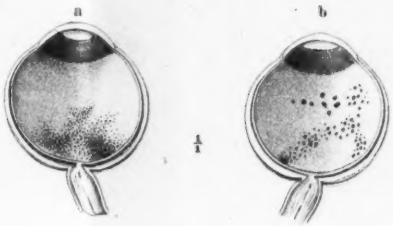

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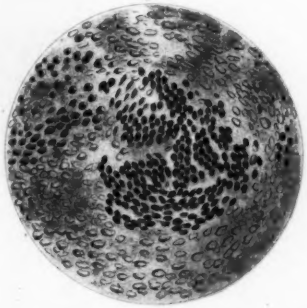

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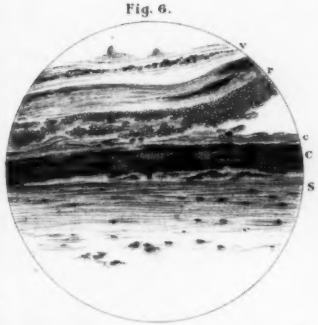

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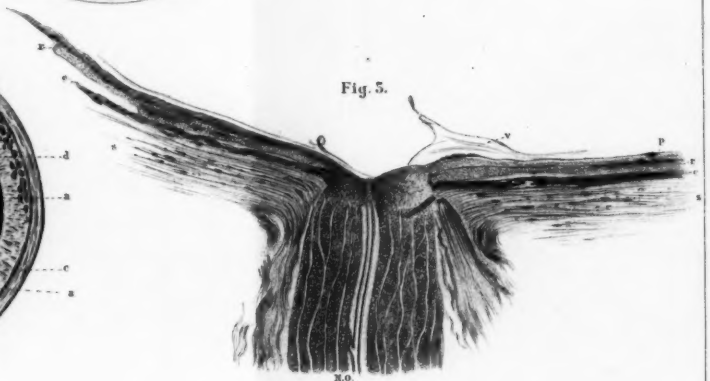

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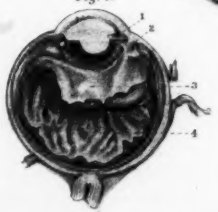
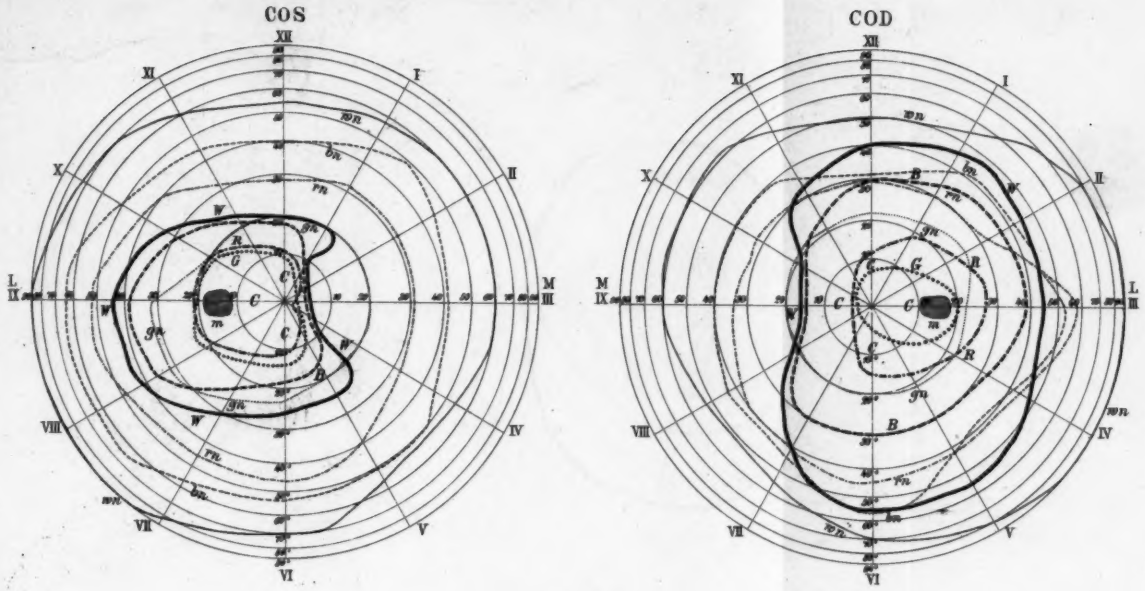


Fig. 8.

Fig 1-6. in Mittelberg. Fig 7 in Pagenstecher.

Lith. Anst. v. Werner & Winter, Frankfurt/M.

Fig. 1.



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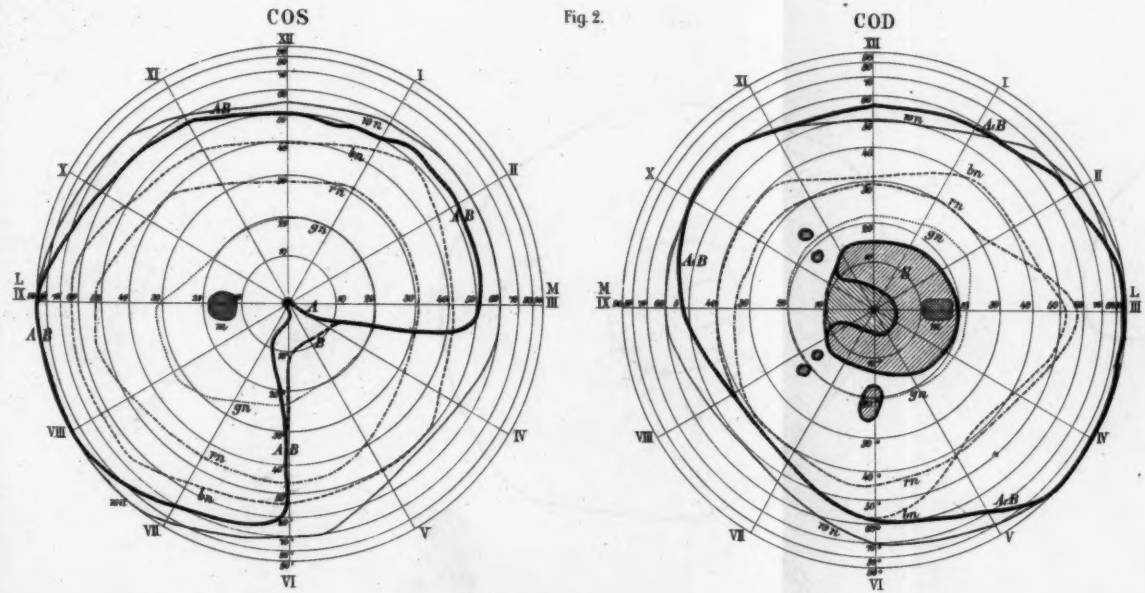

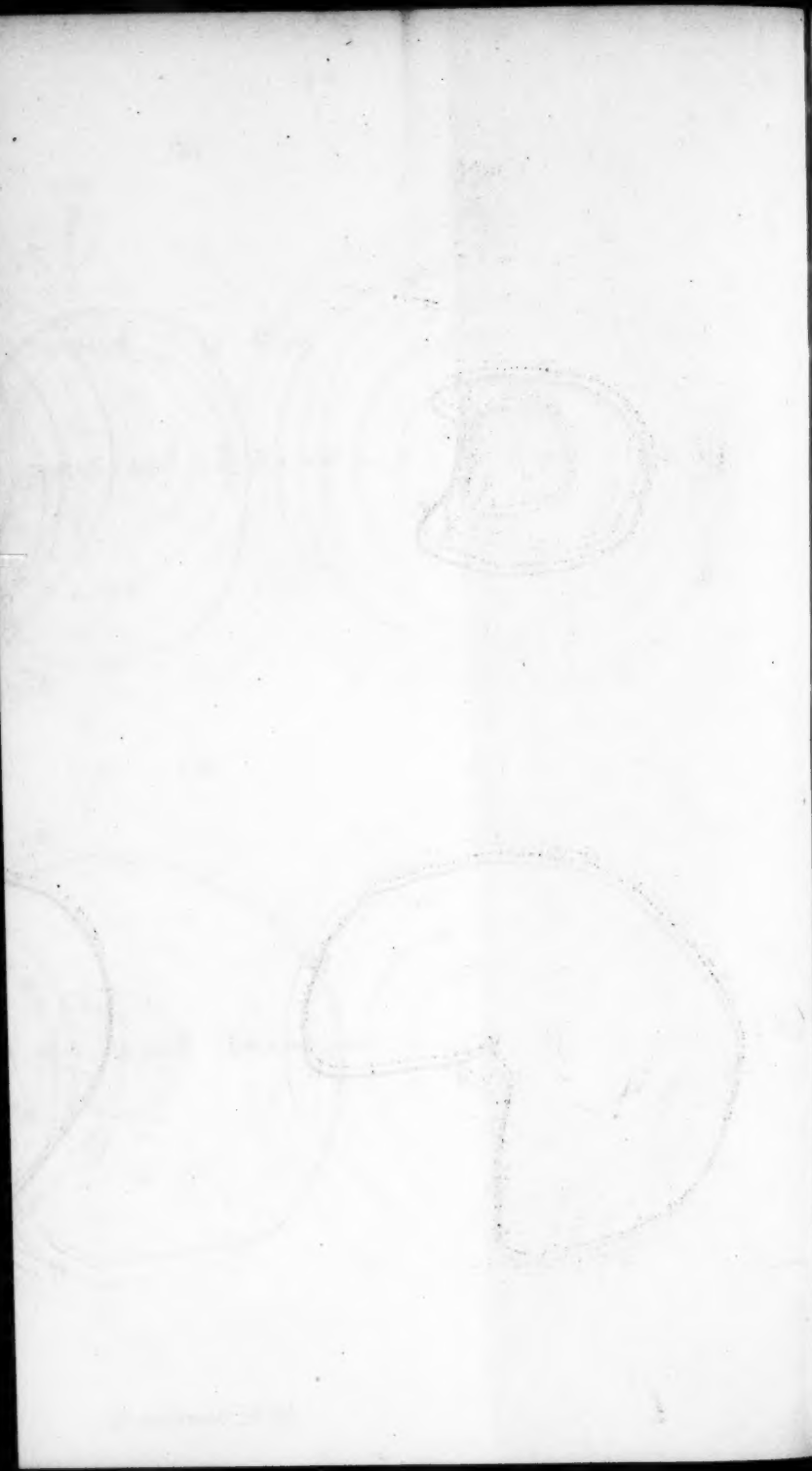

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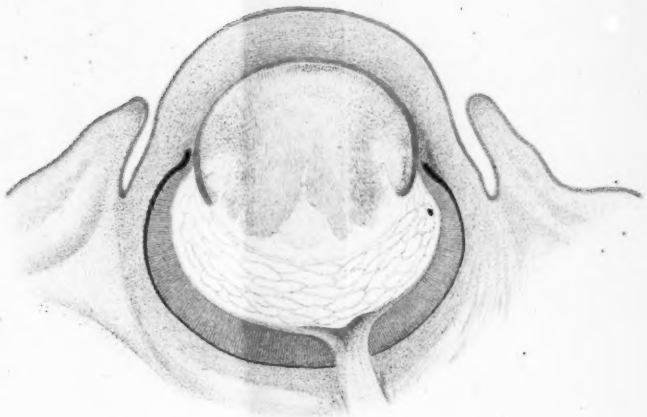

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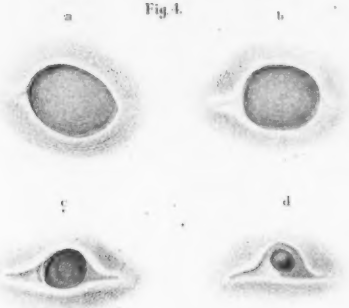

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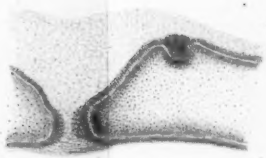

Fig. 11.

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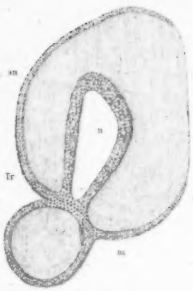

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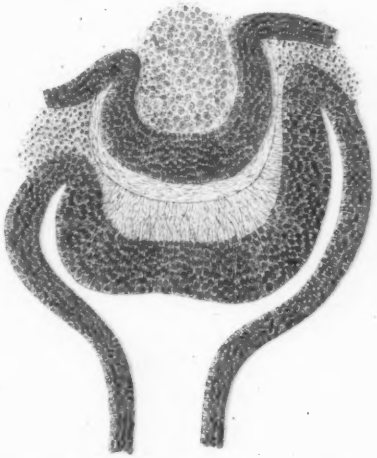

Fig. 19.

Fig. 20.

Fig. 21.